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VIEWS, NEWS AND INTERVIEWS.

The late Dr. Norvin Green, president of the Western Union Telegraph Company, did not leave a will. His estate will be settled as the law provides in such cases. His widow has qualified as administratrix. It is reported that Dr. Green left a fortune of $750,000. Under the Kentucky laws one-third of that goes to his widow, which leaves $500,000 to be divided among his four sons and two daughters.

At last the stray dogs and mongrel curs that infest the streets of Paris are to be put to a good use. They are to be skinned and their hides are to be tanned by electricity. The skins, it is claimed, are transformed into leather in a much shorter time by this means than by the ordinary method.

A correspondent informs me that popular feeling runs very high just now at Biddeford upon the question of purchasing the local electric light works. Some say the price asked is exorbitant, but many are enthusiastic enough to want it at any price. A local celebrity the other day visited a well known dentist to have his aching molars extracted. Seeing the condition of his patient the operator remarked, "You had better take gas, sir." "Gas!" ejaculated the victim of toothache. "Gas be dommed; let's have the electric light!"—*London Lightning.*

The telephone service between New Albany and Louisville, Ky., is rendered useless at night during the present stage of high water. The wires pass over the Kentucky and Indiana bridge, and when the river is high it is necessary to swing the draw to allow boats to pass down, which breaks the wire and connection. The wires are repaired every morning about 9 o'clock, but are broken again when the packet boats pass down about 5 o'clock each evening. Wouldn't it be a good idea to substitute cables for this makeshift device?

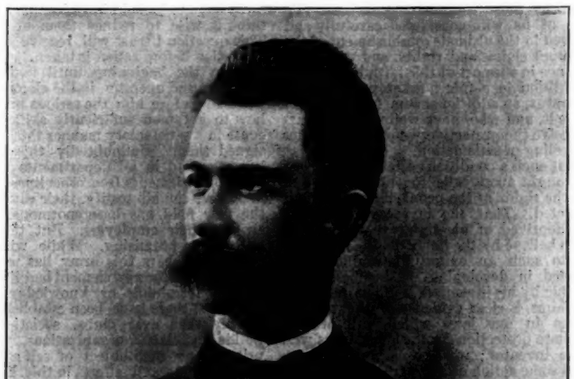
The tug "Western Union," belonging to the Western Union Telegraph Company, has been engaged in taking up the 2¼ inch cable running from the Barge Office to Ellis Island. The cable was broken by the anchor of some vessel, a piece about 2,200 feet long being dragged away. The parted ends were picked up by the tug to be carried to Jersey City for repairs.

Sir William Thomson, in his address at the anniversary of the Royal Society, stated that, to his mind, terrestrial magnetic storms are not due to the action of the sun. To produce a moderate magnetic storm of a few hours' duration, he said, the sun would be required to do as much work in sending magnetic waves through space as it does in four months in giving light and heat. The seeming agreement between magnetic storms and sun spots by this reasoning would appear to be a mere coincidence.

Edward Ambler Armstrong.

THE NEW PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Edward Ambler Armstrong, who has just been elected president of the National Electric Light Association, has been prominently connected with the central station interests of Camden, N. J., for several years past. Under President Ayer's administration Judge Armstrong served as first vice-president of the Association, and previous to that he had been connected with various important committees of the Association. His addresses and general advice upon matters concerning corporations have been of great value to the central station interests represented in the National Electric Light Association.



EDWARD AMBLER ARMSTRONG,
PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

Judge Armstrong was born at Woodstown, Salem County, N. J., and received his education at the Woodstown Academy and the Millville, N. J., High School. In 1876 he entered the law office of George N. Conrow, and, upon the death of the latter, finished his studies with Benjamin D. Shreve, being admitted to the bar in 1880. Judge Armstrong was elected to the New Jersey Assembly from the first district, Camden County, in 1883, and upon his re-election in 1884 was made Speaker of the House. At this time he was 26 years of age, and the youngest man who had ever occupied that position. He was elected for a third term in 1885 and was also re-elected Speaker. He discharged his duties as Speaker with great ability and impartiality, not a single appeal being taken from his rulings during his last session. At the close of both sessions he was complimented by resolutions eulogistic of his conduct in the chair. He was appointed Judge of the district court of the city of Camden in 1889.

Judge Armstrong was elected president of the Camden Lighting and Heating Company in 1889, and in 1892 was made president of the Board of Public Works in Camden and solicitor and director in the Camden Electric Railroad Company. Judge Armstrong has always had the interests of the National Electric Light Association completely at heart, and under his administration during this the World's Fair year, the Association may be expected to make considerable advances.

A movement to build an electric road to connect Allentown and Philadelphia is under way. The president of the company is ex-Mayor William R. Grace, of New York city. J. F. Gwinner, of the First National Bank, of Easton, is the treasurer. Among the board of directors are T. J. Swift, of Poughkeepsie, N. Y.; W. L. Turner, and other well known capitalists. Prominent Philadelphians, whose names do not appear at present, are also connected with the scheme, while it is said Daniel S. Lamont and other well known New Yorkers are large subscribers to the stock. H. S. Cavanaugh, of Easton, is the attorney for the road, and W. F. Pascoe, South Easton, the engineer. The capital is $1,000,000.

THE ST. LOUIS CONVENTION.

SIXTEENTH MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, HELD AT ST. LOUIS, MO., FEBRUARY 28, MARCH 1 AND 2.

A Successful Gathering—Large Attendance—Interesting Addresses—Valuable Discussions.

FULL REPORT OF THE PROCEEDINGS, WITH THE PAPERS READ BEFORE THE CONVENTION.

Tuesday Morning Session.

President Ayer called the sixteenth convention of the National Electric Light Association to order at 10.45 o'clock, on Tuesday morning, February 28, in the Bell telephone building, at St. Louis, and introduced Hon. E. A. Noonan, Mayor of St. Louis, who welcomed the delegates, as follows:

Mr. President and Gentlemen of the Convention: In the four years of my official term I have had occasion to address bodies of gentlemen representing in convention the great forces, I might say, of modern civilization; but at no time have I had the pleasure to address those concerned in what to my mind is now the greatest, the most wonderful, the most far reaching, of all forces known to man, the force of electricity. Like a bold gleam of lightning it is illuminating and dazzling the modern world. Its lustre is being shed upon all the actions of man. It has changed the methods and manners of the ways of man. It has added force and power, where force and power heretofore was impracticable. It is bringing into service much that heretofore was either out of service, or not fully within the service of man, because of the inability to accomplish the ends through the medium of steam. And to where and what extent it will carry us is a problem not within the vision even of the wizards of your profession.

You have come together in council in the greatest electric city of the world. (Applause.) Although somewhat in the far West from where energy is supposed to reside, along the Atlantic seaboard, although we are in a great valley where we are charged with lethargy and the taint of the lassitude that comes with a southern breeze; notwithstanding that, we find in this city, of more than half a million people, the greatest electric plants in the world. The birth of this great power took place before the Christian era; I am wrong, it was born with the primitive and primeval forces; it was born when light was born, when Ayer came. (Applause.) I mean to say that it was dis-

covered, or rather known to men earlier than the Christian era, but that its development is modern.

I will not delay this representative body of gentlemen. You are familiar with the subject; you are masters of a science that to the layman is much of a mystery. Neither time nor opportunity has permitted me to become, even in the way of an amateur, familiar enough with the subject to warrant me to go any distance into that strange and remarkable field. Therefore, permit me modestly to retire from it and leave it where it belongs—to the men who have mastered it, who are making it the study of their lives, who are giving to it all that the artist can give, all that the enthusiast does give. Let me rather go into the channel which I should follow; the channel that brings me here; the channel of hospitality, of reception, of entertainment.

I represent the people of St. Louis. On this occasion, especially, have the public press announced, and in a hundred different ways it has come to me, that so far as this particular convention is concerned, St. Louis will outdo herself in making life pleasant and agreeable for the gentlemen who have come here to deliberate in our midst upon these important matters. (Applause.)

Now, gentlemen, in all seriousness, this is the most important convention, in my humble judgment, that St. Louis has ever had; not in numbers of delegates, not in the great acclaim that has attended your arrival, but in the light of what you represent, in the sense of what will be accomplished by reason of your sessions here. I have found it well in my public experience to hide my ignorance on subjects with which I was not familiar by being as brief as possible. I was caught this morning by your committee reading an elementary book on electricity. It told me all about Mr. Faraday, one of the greatest men of all times, about our good, kind and lovely philosopher Benjamin Franklin, and about the different discoveries of the past, but it shed very little light upon the developments of the past 10 or 20 years in the electrical world; and they are the things this convention would want to know about if they cared about hearing anything at all on the subject from a man not in the business, so you see I have failed to get the information. I was an attorney at one time in an insanity case, and it fell to me to cross-examine the medical experts. I knew very little or nothing of the subject, and so took an opportunity of conversing with one of the medical witnesses, and learned more from him in an hour's talk than I would have done in days and days of book reading. Following this experience, had the thought occurred to me in time, I would have sent for my friend Ayer. I would have had him talk to me in that charming manner of his, and, in the language of the day, would have come down here and "paralyzed" you. But, gentlemen, I cannot do so, I will give way to some gentleman who is clearer on the subject, whose light is more dazzling, who can, rhetorically, couch in the flowers of speech some of the beautiful things that you are doing in the electrical world.

Gentlemen, the city of St. Louis is yours, your wife's, your daughter's and your sweetheart's, if you have any with you. (Applause.)

President Ayer then introduced Mr. Robert McCulloch, president of the St. Louis Electric Club, who said:

Mr. President, Ladies and Gentlemen: I did not expect this of Mr. Ayer. He has followed the mayor's directions and begun his paralyzing. I can only repeat what the mayor has said, and that is, that the city belongs to yourselves, your wives, your daughters and your sweethearts. (Applause.)

The President then read his address, as follows:

Address of President James I. Ayer.

Gentlemen: At this, our sixteenth Convention, it gives me much pleasure to receive you in a city which can display such an appreciation of the work in which we are engaged: to welcome you in my home and be able to present to you the attractive programme that has been prepared.

Since the first meeting, in 1885, at our sister city by the lakes, we have spread upon our records evidence of the wonderful progress of the great industry which we represent, and while, as measured by time, the years are few, the progress is marvelous. No art, no industry, no science can compare with it; and in no more forcible manner can it be presented than by stating that there is more capital invested in St. Louis in the application of electricity to-day than the sum total of investments throughout the United States for the production of apparatus and its use when this association was born. These are facts well known, yet hardly realized by those of us who are engaged in promoting this remarkable development. In St. Louis we have installed 266 dynamos in central stations and various private plants, supplying current to 185,000 incandescent and 5,330 arc lamps; a total of 1,800 horse-power capacity of generators, supplying 660 motors for operating almost every character of machinery, and 8,240 horse-power in generators, operating 1,126 street car motors, over 160 miles of road; and the roads under construction, to be completed within the year, will add 8,000 horse-power in capacity and 96 miles of road. This will make a total generating capacity of 30,000 horse-power.

There are nearly 60 square miles of territory supplied with arc and incandescent lights, and which is crossed and recrossed with electric roads. The changing from steam and cable to electricity for motor power has transposed a bankrupt road into a most valuable property, and successful cable roads are to be changed at much expense to electric, that they may be more successful. This exposition of the development of this industry is what St. Louis has to offer for your inspection.

Since our last meeting much has transpired of interest to the members of the Association. Important developments have been announced from time to time through the press, as the result of the work of inventors, and many valuable items of detail have been brought out to add to the efficiency and satisfactory working of existing apparatus. The commercial development, however, has been confined to improvements in well known apparatus, and not to radical departures in character of generators, as many were led to expect a year ago. More light will doubtless be given us in this direction through some of the papers we will be favored with; but there seems to be little likelihood of the introduction of new methods soon, which will affect the quality of investments in existing apparatus, though there is reason to expect in the very near future that which will likely solve the problem of long distance transmission in a satisfactory manner. The much desired power motor for simple alternating circuits we are still anxiously looking for, and for some applications such motors as are known to be practical should be produced.

The recent patent decisions have introduced a new condition to many, brought anxiety and trouble to some and satisfaction to others. To those of us who were lulled into security by the tedious delays of the courts and the persuasive arguments of our friends, the salesmen, who had so many advantages to offer, comes anxiety. To those of us who have only recently entered the field and who heard very little of claims for "foundation patents," it is a new condition we can hardly realize, and we doubt its reality, and we are strengthened in our doubt by those who don't want it so. To those of us who considered carefully and believed in the ultimate establishment of the inventor's claims and rights, and who gave evidence in support of this faith by paying, in addition to a fair market price for the apparatus, an additional sum for the right to use it, and who have waited many years to receive the protection we paid for, comes the feeling of satisfaction.

That such a condition as exists to-day can be brought about calls for prompt action, that the rights of the people may be better protected. That the inventor can be so long deprived of his rights that many are led to believe by the delay that he has none, and to such an extent that millions are invested in developing a business made possible by his invention, without regard to his claims, is clear evidence of the need of reform in our laws which will provide adequate protection for the investor, as well as the inventor; and we earnestly recommend some action on the part of this Association that our properties, which have been so long regarded with distrust and suspicion by the financial world, may not have added to their burdens the question of their right to use devices which are vital to their success; and to so place the station manager that he must not add to his other essential qualifications that of being able to divine what the courts may do in the far future. At previous conventions this topic has been considered and efforts made to have Congress take such action as would give relief. Work in this direction should be taken up again by this body and vigorously pushed to completion.

I note with much pleasure that since our most interesting and delightful visit to Montreal most rapid advancements in electrical interests have followed, and that the Canadian Electrical Society has, at a recent meeting, given much evidence of remarkable growth.

That, with the greatly increased business of our electrical manufacturers, notwithstanding the protection wall over which their "heavy" products have to be lifted, indicates that our time was well spent; that there was developed a friendlier feeling and closer intimacy, besides giving an impetus to electrical development for which they seemed to have been waiting. I believe our visit has done much to hasten the time when there will be no wall between one country and one people.

The preparation for the World's Fair is rapidly nearing completion, and in a few short weeks there will be opened to the visitor one of the most magnificent achievements of modern times—an engineering and electrical wonder. In no particular is it more remarkable than in the department of electricity. This in its ramification permeates all departments and will make possible most marvelously beautiful effects, as well as prove the most useful of servants. Too much praise cannot be awarded those who have labored to produce this most complete exposition of the development of the science in all its forms.

The American Institute of Electrical Engineers are doing much to assist in the arrangements for a fitting meeting of the electricians of the world, and our committee will present a report which, with the information received from a representative of the World's Fair, will enable us to act in the best manner to show the national and patriotic character of our organization.

In the past year much work has been accomplished by our secretary, and the showing for the year will, I feel, be very satisfactory when his report is read. Three volumes of the association proceedings have been edited, published and delivered to members within the year, bringing this work down to date. Because of the accumulation and large amount of matter contained in each volume, this has been no small task, and the creditable results obtained in the handsome volumes, together with the thorough manner in which the office has been conducted, make it but a simple act of justice that I express my thanks and commendation at this time.

The interest in the proceedings of the convention evinced by the educational institutions throughout the country is one of the encouraging signs of the times, and justifies the statement (which is evinced in many other ways) that the power and influence of the association are extending. The increase of membership is flattering. With this condition existing there will come up for your final consideration the question relative to the reduction of dues. While present conditions indicate that we can with safety reduce our dues, and possibly increase the membership beyond its natural growth under the present rate, yet there is much work which can be carried out to the benefit of the association, which would have to be neglected if our revenue is reduced. The dues at present are hardly a burden, and a balance on the right side of the ledger is essential to the prosperity of any institution. While a change in the dues would not affect our treasury for more than a year, during which there will be extra expenses on account of the meeting which will necessarily have to be held in Chicago, I do not think it wise to reduce them at present. This question I trust will receive due consideration before action is taken.

From the beginning until to-day every producer and operator in the electrical field has had before him the serious problem of how to get men sufficiently skilled to execute in a satisfactory manner the duties assigned them. Undoubtedly this business has attracted in all departments the most ambitious elements from other lines of work, but as we can all testify, their education in the new field has been enormously expensive to their employers. But the future outlook is promising. While within the past three years this army has more than doubled, and the new element had little or no previous training or knowledge of the work, yet there have been established more rapidly than ever clubs, societies, trade guilds and labor organizations, with the principal avowed object of self-education. Their objects and efforts in this line are to be commended, and form a pertinent topic for this body to consider. In St. Louis we have among societies of this class, an organization known as the Electrical Exchange, composed principally of contractors whose particular business is to do the electrical construction required in all modern buildings. Their prime object in organizing was that the execution of this work might be confined to those who were responsible and maintained regular establishments. Their endeavor is to so execute the work entrusted to them that they may command the respect and confidence of the central station manager, owner, architect and builder. To this end they meet for discussing improved methods, and such other matter as may be suggested and calculated to be of mutual benefit. Insurance inspectors, supply houses and central station companies are eligible to membership. In contact with them we find them ever ready to co-operate with us in any movement to improve the service and increase the satisfaction of our customers; and since their organization a much better feeling has been established and the quality of work greatly improved.

Within the past year has been organized the National Association of Electrical Workers, with headquarters in this city, and having branches in many towns and cities. This organization is largely composed of linemen, though it expects to embrace in its membership electrical artisans or workers in every department. Their principal object is, as stated in the first number of their journal, to band themselves together for mutual education and improvement; to establish rooms and provide instructors, and adopt such other methods as may improve the standard of electrical labor. This organization is capable of accomplishing a vast amount of good, if maintained on the high plane outlined. If the effort is earnest and honest we can all lend them a helping hand and will do it gladly. The wage question will never be an element to make a breach when the rank and file of electrical workers have mastered their business. But until that time arrives those who are among them as leaders should keep in mind that satisfactory work performed in a conscientious manner is the first essential to pleasant mutual relations between the employer and the employed, as well as the strongest lever to raise wages that can be produced. Thoughtful care on the part of the manager must be given that the man who climbs the pole to clear a ground or close a circuit, in the sleet and rain, and all others as well be protected by all safeguards in the way of instructions and appliances that can be suggested. The engineer, the dynamo tender, the lamp trimmer, all must be encouraged in their efforts to improve in knowledge by active co-operation on the part of the management. A close acquaintance with our employés is an essential to a full appreciation of their services. Many acts of real heroism are performed by the lineman or the dynamo tender, only that the service may not be interrupted, and that many times without a passing comment. We can shake out the crosses and clear the grounds by a closer acquaintance with our men and their work.

We have for consideration a splendid list of papers, which is varied, and yet devoted to topics which I trust and believe will develop that interest which will bring members to their feet in thoughtful discussion. The discussion on the papers and such topics as may come before you I trust will receive the usual dignified treatment and earnest interest which has always obtained in this body.

During the year that has passed death has claimed an unusual number whose names have been prominently identified with the active promotion, development and application of electricity in its various branches. Those particularly interested in the department of telegraphy were Cyrus W. Field, Wilson G. Hunt, F. M. Gisborne, Jay Gould and Norvin Green. In electric lighting and railways, C. J. Van Depoele, E. T. Lynch, Jr., M. M. M. Slattery, and in Europe, Werner Von Siemens. In this list are the names of those who have borne much of the heat and burden of the day, and were among the few pioneers who hewed the path and assisted to broaden the road, by overcoming difficulties which we, who find it so comparatively smooth to-day, little appreciate.

To our guests who have assembled with us and honored us by their presence, and who will further honor and instruct us with their words of wisdom, I want to express our thanks; and I trust that the members will by their presence at the different sessions demonstrate the sincerity of this expression on their behalf.

At the conclusion of his address the president declared the Sixteenth Convention of the National Electric Light Association formally opened.

The president announced the burning of one of the largest stations under the management of ex-President Huntley, at Buffalo, and read the following telegram;

I regret my inability to be present. You have my best wishes for a successful convention. C. R. HUNTLEY.

The paper by Mr. A. D. Adams on "Wrought *vs.* Cast Iron for Field Magnet Frames" was then read.

There being no discussion on the paper just read, the secretary made several announcements.

Letters of regret were read from Prof. Henry T. Bovey, Montreal, Can., and Prof. E. L. Nichols, Ithaca, N. Y.

Letters of invitations to participate in courtesies were read from the Merchant's Exchange, St. Louis; Bell Telephone Company, St. Louis; Pastime Athletic Club, St. Louis, and the Knapp Sellner Chandelier Company, St. Louis.

An invitation to hold the next meeting of the Association in Omaha, Neb., was read from Hon. G. P. Bemis, mayor of Omaha.

On motion of Mr. Armstrong, the latter was referred to the proper committee, and the former were accepted, with the thanks of the Association.

The president stated that there would be open house at the Electric Club, at all times of the day and night, where a buffet lunch would be served, and to which all in attendance at the convention might resort at any time.

The president read the programme of entertainment provided by the local committee, a copy of which will be found elsewhere in this issue.

Mr. E. A. Armstrong, then read the report of the committee on the World's Columbian Fair, the chairman, B. E. Sunny, not being present.

REPORT OF THE WORLD'S EXPOSITION COMMITTEE.

The Paris Exposition, of 1881, was lighted in part by 1,383 arc lights, and was the first arc lighted exposition. The Louisville Exposition, of 1882, was lighted by 5,000 incandescent lights of 16 candle-power each, and was the first use of incandescents for exposition lighting. The New Orleans Exposition was lighted by both arc and incandescent.

The Paris Exposition, of 1889, made the largest use of electricity up to that time. There were for public lighting service 1,093 arcs and 8,837 incandescents.

For private lighting there were used 623 arcs and 4,010 incandescents. The total of the service installation aggregated 3,125 horse-power capacity, and with small installations, the grand aggregate capacity reached nearly 4,000 horse-power. There was practically no use made of electricity as a motive power.

The World's Columbian Exposition has placed contracts for 4,500 arc lights, of 2,000 nominal candle-power each, and received donations from miscellaneous exhibitors of about 700 additional. They have placed contracts for about 80,000 incandescent lights and received donations as special exhibits of about 10,000 additional. They have place contracts for 2,900 horse-power capacity of power generators and received donations of 1,600 horse-power capacity.

They have made contracts for electrical fountains requiring an installation of 900 horse-power capacity. The aggregate of power generators and fountain plant (the latter will be used particularly for charging the storage batteries of the electric launches) is 5,300 horse-power.

The total aggregate of the electrical installation therefore amounts to 19,500 horse-power. The total aggregate of boiler capacity employed is 18,000 horse-power on the standard rating of 30 pounds of steam per horse-power. With such efficiency as should be expected from the engines installed, this represents an effective total of about 24,000 horse-power.

The most interesting point of this plant will be the use of oil as a fuel. From the time the crude petroleum is emptied from the railroad tank cars into the World's Fair storage tanks, at the extreme southeast corner of the grounds, this oil becomes part of the power plant, the pressure upon the delivery pipe being automatically controlled by the steam pressure in the boilers. Delivery to boilers is made by pipes laid underground from the storage tanks to the boiler house, and the oil introduced into the furnace through an atomized jet.

A point of exceeding interest in the engine and dynamo room will be the very large adaptation of dynamos to Corliss and medium speed types of engines in direct connected combinations. The largest of these will be a set of vertical triple expansion engines with two connected armatures. At 160 pounds steam pressure this single unit will give most economically 1,200 horse-power, with a capacity for a continued service of 1,500 horse-power output.

Next to the universal distribution of electric power for all points of the grounds, the most marked advance of the time is the application of electricity to the transportation service of the exposition. This service will be by a three mile double track elevated railroad, following all the precedents and best practices in block signalling systems, power brakes and all other safeguards of the modern steam railroad used in exclusively passenger traffic. The entire operation will be, however, by electric power drawn from an independent power plant of more than the aggregate capacity installed at the Paris Exposition. In this power house will be found the latest examples of the large range of direct driven power generators, five in number, and aggregating 3,500 horse-power capacity.

To those who have not had an opportunity of informing themselves of the part that electricity is expected to play at the exposition, these figures will be interesting and will indicate to all how much greater by comparison with preceding expositions the Columbus Exposition is bound to be.

The sensational reports telegraphed from New York that many of the prominent electrical firms in that State had decided to abandon the space alloted them and make no exhibit, were found on inquiry to be based on the fact that three small concerns had gone out for reasons that were personal to them. Every foot of space in the great building has been taken and every electrical concern of any consequence in the world will be fully represented.

The active work of preparing for the exhibits has been going forward for some weeks and many of the electrical firms have made substantial progress in the erection of their booths.

The intellectual programme under the auspices of the World's Columbian Auxiliary, promises to be of remarkable interest. As you know, Prof. Elisha Gray is at the head of the electrical branch, and he now has assurance that the gathering of electricians from all parts of the world will be a grand one. Respectfully submitted,

B. E. SUNNY, *Chairman.*

At the conclusion of the reading of the foregoing report, the meeting adjourned until 2 o'clock.

Tuesday Afternoon Session.

The president called the meeting to order at 2.30 o'clock. The first business of the session was the reading of the paper on "Relation of Insurance to Electric Lighting and Power," by Mr. William Brophy.

The President: You have listened to a paper from one that many of us have learned to respect and value as one of the most active agents in developing the electric lighting business, in the way of restoring to the public confidence in the harmlessness of our wires and to give them faith in the continuity in the service. Primarily, his interests were for the insurance people; but his close relations to the central station men formed in looking after the insurance interests made him a strong advocate and a strong supporter of the development of electric lighting. His work was done at a critical time. His paper is of such character, emanating from the insurance standpoint, that it cannot fail to be of great value to the interests represented in this Association.

Mr. Hammer: It seems to me, in view of Mr. Brophy's remarks, that it is possible a closer union could be established between the National Board of Fire Underwriters' Association and the men who are actively engaged in the electric light enterprises, by having a joint committee composed of members of the National Board of Fire Underwriters' Association and of the National Electric Light Association, who should come together and compare notes, and have a report issued which would be a joint report. From what the chairman of the Board of Fire Underwriters told me there is a feeling of considerable jealousy on the part of that board as regards the report issued by the National Electric Light Association. They feel that they should not be dictated to by this Association, and naturally enough we feel that we should not be dictated to by them.

Mr. Brophy: I have no objection to any rules that may be made by the Board of Fire Underwriters, so long as they do not exact undue concessions or place undue restrictions on the business. I have lately come into possession of certain rules issued by the National Insurance Board, as they style themselves. They vary but slightly from the rules issued by this Association; and I really recognize my own work in them. I suggest that our standing committee on safe wiring before the next meeting compare these two rules, and if possible work in harmony with the insurance companies. There is no reason why there should be any antagonism between the two. It is certainly as much to the interest of the members of this Association to reduce the fire hazard from electric lighting as it is for them. I think there is no doubt that you are willing to do it; there is no occasion for having two sets of rules, or having any misunderstanding about them.

Mr. Francisco: I have been an insurance adjustor for about 25 years, and know something about the knowledge which most of the insurance agents have about the electric lighting business. Nine-tenths of them do not pretend to know anything about the electrical part of the business. There are a few insurance men that understand it. There are a great many things we ought to take into consideration. There are points in these rules that certainly should be amended. If the electric light men will take up this matter and push it to protect their own interest, they can reduce rates to a minimum and get good insurance. The high rates are the result of the haphazard, loose way of construction and arrangement which prevails in many places. We find all kinds of poor and ill-advised construction. I would never place my dynamos on a flooring of timber. I would have a stone or brick floor laid in cement and place my dynamos on that. Capt. Brophy says your wire should be above the floor and below the ceiling. I can stand in one position in my station and see every wire in the station.

Mr. A. F. DeCamp, of Philadelphia: I think the rules adopted at the Montreal convention were good rules. It has occurred to me that it might be a good plan, instead of having this committee meet to consider and adopt these rules, to have it resolve itself into an arbitrating committee. If the committee is made up of men acceptable to both parties, we are sure to get better results.

Mr. Issertel: I would like to ask why these rules are not universally accepted? I find that in one city a certain set of rules, and in another city, especially in Pennsylvania, another set entirely different are carried out. I would like to know which set of rules is standard?

Captain Brophy: Of course, it takes a good while to overcome local pride and prejudices. It seemed to be the proper thing to take a set of good rules and change them, so that they would be considered a local production; and in this way much of the variation came about. The meeting was called at Cape May in order to get a uniform set of rules that would be in force from Maine to Texas. I do not think they have yet been promulgated.

Mr. Armstrong: The underwriters are the ones who should make the rules. They are the particular ones who insure the properties. While it is true that we, as electric light managers, are equally interested with them, because by that craft we have our livelihood, still we must recognize the fact that they are the ones who have to run the risk and bear the loss when it comes. Mr. DeCamp's idea of having a committee of arbitration is a good one; let the thing be done. It is an excellent plan; the only question is will it work?

Mr. DeCamp: I would like to ask if any set of rigid rules would be susceptible of being carried out to the letter; whether some discretion has not to be left to somebody?

Mr. Brophy: I have had a large experience formulating rules, and it is my judgment that a rule was never yet made that would not be deviated from. There must be some discretion left to the constructor, to the man who is furnishing light, or to the insurance inspector. For this very reason our committee is a standing committee, so that we can at any time add to, or change, or modify these rules whenever it becomes necessary.

Colonel Meyer announced that President Scullin, of the Union Depot Railroad, would provide special cars for such of the delegates as desired to visit the power station of the company in the evening. The paper by Mr. R. H. Sterling was then read on "Some Experiences with the Alternating System."

The President: Gentlemen, you have before you one of the most interesting papers that you are likely to have an opportunity to discuss; and I trust the discussion will be free and full. The closing sentence of that paper, and the last word of that sentence, is one of interest to us all. The production of dividends is the thing we are all after; and Mr. Sterling has brought out matter which will promote that end.

Mr. Sterling, being called upon for a fuller explanation of the "booster" referred to in his paper, said that Mr. Wagner could explain it fully.

Mr. Wagner: I understand that Mr. Stillwell is to be here, and as he is the inventor of the arrangement called the "booster," or more properly, the Stillwell regulator, he will be more competent to answer it than anyone else. It is rather difficult to explain it without the use of a diagram or blackboard. It is simply a converter arrangement used to raise the potential at will on any circuit or feeder, by means of series contacts usually differing about one per cent. The regulator as usually constructed may be used to raise the potential on any feeder from one to 20 per cent. It is a simple converter with ordinary coil connected in the usual way in multiple, with the circuit or shunt to the secondary coil, which is adjustable in length, or has a number of ends brought out, placed in series with one leg or one side of the feeder, and adding its potential to that of the line or the dynamo. That is about as well as I can explain it without the use of a blackboard.

Mr. DeCamp: I would like to hear this subject discussed. I am not in this line of business but cannot tell how soon I may be.

Mr. Wagner: In regard to the flexibility of the alternating system and the possibility of using the station units to their utmost capacity, I have never in my practice found it necessary to run any station unit under 75 or 80 per cent. of its total capacity. By a very simple switchboard arrangement, it is possible to connect as many circuits to one dynamo as is desirable, and as the load falls off the station, the units or dynamos are shut down and the feeders are gradually brought together on a few number of dynamos, and in that way the station apparatus can be used as economically and advantageously as with direct current. We couple the circuits together instead of coupling the machines together, and that can be done without interrupting the service for even a moment on any circuit. It has now become possible to run arc lamps as well as motors on the alternating circuits; and I think that it has at last become almost universally conceded that for most purposes the alternating current is as flexible as the direct current. In this town we cover an area extending six or seven miles from our station in several directions. The station is situated almost at the center of the district, and in that district we have between seventy-five and eighty thousand lights; and we have never had any trouble from want of flexibility of our machines or circuits, so far.

Captain Brophy: This is a rather delicate subject for me to handle; but I want to call attention to one point. In the earlier work it has too often been the case that the only thing men considered necessary was to run out a pair of wires, paying little heed to size, drop, or anything else, and attaching transformers to them. Of course, where you have four or five circuits, neither one of them of the same size or less, you cannot couple them together and do satisfactory work; and you will find in many of the smaller stations, and for that matter, in many of the larger ones, a difference in circuits, a difference of drop anywhere from five to 15 per cent. This is one cause of trouble that a great many stations do not seem to understand.

Mr. Wagner: This suggestion again brings up the subject of the "booster." It is just as possible with alternating circuits as with direct circuits to use feeder regulators. The feeder regulators ordinarily used simply throw resistance in the circuits; and if there is one circuit which is run from one dynamo, or a number of dynamos connected in multiple, which has a ten per cent. drop, all other circuits connected therewith must have a resistance thrown in to bring them down to the same pressure as the one feeder with the ten per cent. drop. That is done with feeder regulators, or by throwing resistance, or by cutting out feeders. In a properly constructed alternating system it is just as necessary to use a system of feeders and mains as with the direct system. Generally, the same devices can be used for regulating either current; but the Stillwell regulator is a device which can only be used on alternating circuits, and is much more economical to use than any other form of feeder regulator using resistance, as this regulator raises the potential of any one circuit instead of lowering it. The circuits with small amount of drop are left as they are, and those with greater load are raised in potential sufficient to bring the potential at the end of the feeder to the proper standard.

I believe it is usually customary in direct current systems to connect all the feeders and mains together, forming a complete and continuous network. It is claimed as an advantage for the purpose of keeping a uniform pressure throughout the system. It occurs to me that it has a distinct disadvantage in case of ground or trouble occurring on the line. It then becomes very difficult to lock it. In the alternating system it is used to keep each feeder and its system of mains entirely separate outside of the station, simply throwing them together in the station. Any short circuit or ground or burn out, any trouble occurring on one of the circuits is immediately indicated by the station instruments or fuses, and is located and confined to quite a small district. It can very much more quickly be repaired than if all the feeders were connected together, and a great number of miles of wire had to be inspected in order to find the trouble. This is one of the advantages of this kind of distribution.

Mr. DeCamp: Throwing in resistance is a consumption of energy for which you get no return; and it occurs to me whether the necessity for doing that is not one of the elements against it as an economic method of distribution.

Mr. Wagner: I was going to bring up that point against the direct system. It is not necessary to do this with the Stillwell regulator, which does not throw in resistance, but simply raises the pressure with a very small loss of energy.

Mr. DeCamp: I would like to ask what the average loss is at your station?

Mr. Wagner: I suppose you refer to the average loss in distributing the current. Of course, that is left largely with the engineer designing the station and the circuits. In the case of the Missouri Electric Light Company it varies from five to 10 per cent.; the average, probably, is about eight per cent.; six per cent. in the feeders and two per cent. in the mains. It depends on the proportion between the average load and the maximum load. That differs at different seasons of the year.

Prof. Weston: I presume Mr. De Camp is really seeking information that almost every other electric light man in the world is seeking, namely: What are the respective merits of the alternating current system as compared with the direct current system? The question of the distribution of energy by the two systems under discussion is receiving great attention, both on this side and the other side of the Atlantic. At the present moment, I do not think anyone is in a position to fully answer the question Mr. De Camp raises, namely: Which is the more economical of the two systems? The systems, as established here, differ radically in one respect, at least, from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From present experience it seems as though this was a fundamental mistake, and that the mistake will be more apparent as the system has to be forced underground, which it will sooner or later. We must all recognize the fact that any system of aerial conductors can never give us the safe and sure service which is necessary to enable us to compete with a satisfactory and reliable source of illumination, such as gas. If our alternating current systems of this country were forced underground, the loss would

be, undoubtedly, greatly increased; but what the losses are exactly at present, I have not been able to find out. No one seems to have made any special effort to determine them, and to ascertain exactly how they are distributed. With the direct system the losses are at the lowest point, and are very small, indeed, when the load is very light. The energy consumed then is practically what you use in the lamps; but in the alternating system there is an increase of loss in the converters, as we readily understand. The difficulty of dealing with and ascertaining what these losses are through the wires is serious indeed; and it is impossible, almost, to arrive at them from the actual running plant, because it is very difficult to ascertain the total number of lights in circuit, and how these lights are distributed. To make a test, therefore, that would be really satisfactory, to ascertain the commercial efficiency of the alternating *versus* the direct current system, involves a great deal of labor and careful thought. The constant growth of the alternating current system indicates, however, one thing surely, namely, that it is filling a long-felt want, and that it is a money making investment, at least, for a large number of people. Whether the system, as it exists in this country to-day, will not be radically modified in the next few years, so as to approach more closely the systems of Europe, is a question; but I think it will. I think that will undoubtedly be done, and the tendency will be toward a lower rate of alternation and greater general efficiency. If any gentleman here has made careful determination of the energy transformed, and has compared that with the energy actually used in the lamps, it ought to be brought out. It is a matter that everybody is seeking light on.

Of course, you can get a general idea of the efficiency of the alternating system by keeping records of the total output per hour as indicated by the instruments, supposing them to be reliable, and then summing these up at the end of the month, or at shorter periods, if possible, ascertaining what your watt meters or recording instruments indicate. You would have a rough check in that way. I noticed one remark in the paper in regard to the use of instruments. Instruments are generally placed on the switchboard, and quite frequently so near to the other apparatus as to make their indications unreliable. Some six or eight months ago I had a case of this kind called to my attention. A concern in Philadelphia required a very large ampere meter (3,000 amperes) to indicate the total load on the dynamos. In addition to that, they had provided the switchboard with some six or eight volt meters, to indicate the voltage of the different machines. This was on the direct current system. Right behind these volt meters, two inches or less away from them, was a busbar designed to carry 1,000 amperes. It is claimed that these instruments are not affected by external magnetic fields, but are practically, not permanently affected by them. That may be true, but it does not follow that they would indicate correctly under the conditions of their use as named above. Right behind them we had to deal with a current that may vary anywhere from a few amperes up to 1,000, and under these circumstances the volt meters would never indicate correctly, not even if they were calibrated in position, because they have the variable current behind them, which would variably affect the value of the indications according to its strength. The paper just read speaks of the use of instruments for the alternating current. Now it must not be supposed that the indications of alternating current instruments cannot be affected by alternating currents. It depends on their design and construction. A great deal more care and attention ought to be paid to putting the instruments in such place as will insure their indicating correctly, or being in a position where they are free from the disturbing causes of external magnetic fields. If this precaution is not taken, you are frequently entirely misled, and the instruments are blamed for troubles which are not inherent.

Mr. Blaxter: I would like to ask Mr. Weston a question. Does he think that in going underground with the alternating system that the loss would be greater with the high number of alternations than with the overhead system?

Prof. Weston: I should expect the loss to be greater on account of the inductive influences.

Mr. Blaxter: Would not the concentric system of wiring obviate a good deal of that trouble? Would it not reduce it to such an extent that it would not be any more than with the overhead system?

Prof. Weston: The concentric system is being tried on the other side, and they have met with serious difficulties. I think it will be found that there is a greater loss underground.

Mr. Hammer: There is one point in connection with the comparison between the two currents which has been an interesting one to me, and I would like to know whether there are any gentlemen who have had extensive experience on this point. I refer to the relative life of an incandescent lamp on a continuous and an alternating current. This has been stated by various parties to be a very slight difference. I remember one of the oldest engineering concerns in Europe, quite a number of years ago, published a statement shortly after the introduction of incandescent lighting, that that lamp would last longer with the alternating than with the continuous current; but within a brief period they published another statement that the opposite was the case. It is a well known fact, however, that an incandescent lamp will last longer at a lower rate than at a higher rate of alternation. The question is what is the relative life of a set of lamps working upon an alternating circuit, compared with a set working on the direct circuit, under the same conditions, or as nearly as possible under the same conditions? I would like to know whether any gentlemen here, who have central stations, and who have made tests, will give their experience. It is one of the points which bears on the commercial value of the alternating compared with the continuous current.

Mr. Blaxter: Comparing the alternating circuit with the direct current, I do not think I have noticed any difference in the life of the lamps; but one thing I have noticed, and that is, that a lamp in the city burning in a store will burn out in a less number of hours than a lamp in a residence. Vibration, I think, has something to do with it. I have had a lamp in my own house for three years, and burned it considerably every day. If that was in the city, I think three months would settle it. I think the shaking of buildings in the city has a serious effect on the life of lamps.

Mr. Wirt, of Chicago: I think the difference in the life of lamps in stores and residences can be accounted for. The residence is generally further from the center of distribution, and the pressure is generally lower. I have made tests of that kind, and I think it is pretty safe to say that is the usual state of the case. Regarding the difference in the life of lamps on the alternating and direct current, I think that question has almost been settled by laboratory tests and the result of large experience. It has not been claimed for some time now, to my knowledge, that either system is far superior to the other as regards the lamp life. A recent report on this subject was made in Europe, and it summed up the matter something like this: It seems to us that these results would dispose of the question of the continuity of the life of the lamp on the alternating as compared with the direct current, the results having shown that there is practically no difference between the two.

Mr. Kilbourne, of Seattle: The question as to the relative value of the two systems depends largely on the field you are going to operate in. In Seattle we have both systems and find they do not conflict; and we also find the alternating system just as flexible, and in some respects more flexible than the direct system. If you have a station which is so situated that you do not expect to go beyond a certain limited distance from the station, and your load is liable to be light at certain times of the day, and you want to run all day, there is no question that the direct current is the better and cheaper. The chronic condition of most stations is light loads, and the direct system under these conditions is the more economical; but it is impossible to go beyond a certain distance with the direct current, so I think the question largely solves itself.

Adjourned till Wednesday.

Wednesday Morning Session.

President Ayer called the meeting to order and announced the first business to be the paper by Prof. George Forbes, of England, on "Thermal Storage for Central Stations."

The president said:

In our country it seems to me that this plan of storing water-power is one that can be worked successfully, quite aside from the matter of thermal storage. There are certain parts of our country where coal is very dear, and where everything in the way of power that can be saved should be saved. There are places that are so situated as regards topography that the water storage scheme could, I believe, be successfully worked. For example, there are many places in the western part of the country, through the Rocky Mountain section and westward, where coal is to be had, to be sure, but it is altogether too dear for economic use. There is a little water to be had, but the supply is not steady enough for working the stations by water-power direct. In such cases it seems as though the pumping of the available water into reservoirs might serve a very useful purpose.

As to the thermal storage itself, I will simply say that it seems to present a very important possibility; and I can heartily add that I most cordially agree with Prof. Forbes in the great value of working out a commercial system for the destruction of garbage.

Mr. DeCamp: Do I understand that the system is to first make the water hot in the boilers when he has no use for the steam, and then pass it into the reservoirs, which constitute the economic points?

Professor Forbes: Yes, sir; he passes the steam through a pipe into the water of the reservoirs, and so heats up the water of the reservoir, the top of the reservoir being filled with steam, to a pressure greatly increasing as the water is heated up higher and higher.

Mr. DeCamp: Up to what temperature does he get the water in these reservoirs?

Professor Forbes: The highest temperature is about 407 degrees; he works from about 350 to 407. I think that corresponds to the variation between 120 pounds pressure and 250.

Mr. DeCamp: When the time arrives that he is at his maximum use of power, does he put the hot water that is in these reservoirs back into his boiler for generating steam of sufficient pressure to run his engines?

Professor Forbes: No, sir; the steam in the reservoir, under normal conditions, we will say, is under 250 pounds pressure, and as he gradually takes off the steam in the reservoir to reduce the pressure, the water, of course, begins to boil, and gives off still more steam, so that he always has a supply of steam until the pressure in the reservoir has been reduced down to the working pressure of the engines. When he gets below that, of course, he has exhausted his steam, and has to put in more power from his boilers.

Mr. DeCamp: He has to re-enforce it from his boilers. Permit me as a layman to say that there seems to be an element of perpetual motion about that. In our station we carry our exhaust into two receiving tanks, through which all the water passes, exhaust receivers, and then from that it flows into two storage tanks of 18,000 gallons capacity each, and the water in these two tanks stands at a temperature of 185 to 190 degrees. I don't know to what extent this is practiced; but, of course, it is not new.

Professor Forbes: The method just described by Mr. DeCamp is, of course, one of the numerous methods, using the waste heat in the exhaust for heating up the feed water. Of course, you are saving a lot of waste heat which would otherwise go up the chimney. Mr. Halpin's scheme is for a totally different purpose. It is to get over the waste of coal that there is in heating up the boilers just for a few hours' work at maximum load in the evening. Owing to this fact you have to pile on the coal for a short time, probably using forced draught and working the boilers up, and wasting a great deal of coal in heating them up to the required degree, and then after you have got them nicely to work you have to let them down. That, as I pointed out, in actual central station practice, means an addition of something like 40 per cent. to the coal bill, and that is the economy which Mr. Halpin seeks to introduce.

Mr. Bradley: The idea here seems to be that, as the steam comes into the reservoirs, it is condensed and converted into water, the water converted into heat and the temperature is raised. As the water boils it gives off its heat in the shape of steam, which runs the engine. There is no element of perpetual motion about it. It is a question of storage all the way through. Nature has stored the energy in the coal. This proposition is to store the energy in the steam as it is made in the boiler. Mr. Forbes' proposition is to store the power after he has made the power in the form of steam; the storage battery stores the energy after it is made in the form of electricity.

Mr. Haines: I would like to ask Professor Forbes to give us a comparison of the efficiency of storage of water—raising water to a height—and the efficiency of the storage of steam in his cylinders, which would be of interest to many of us.

Prof. Forbes: The gentleman has asked me for a comparison of the relative efficiency or cost of the system of the storage of water, which I had myself proposed, and that of thermal storage, which Mr. Halpin has proposed. The running expense is almost the same in the two; but the economy of capital, if your reservoir is anywhere near your pumping station, is very much in favor of the water storage. The water storage takes off about 30 per cent. from the cost of a central station built upon the ordinary lines. That was so in the detailed plans which I worked out for the city of Edinburgh, Scotland. Thirty per cent. from the cost of doing it in the ordinary way. The thermal storage is rather more expensive to erect, but the annual saving on these two systems is about the same.

Mr. Hammer: I heard a lecture that Professor Forbes delivered in London on the subject of the utilization of rubbish in producing power. I would like to know what were the results of the experiments in London. Also, will he please state, if a normal central station will use five pounds of coal per horse-power hour, what the amount of rubbish is, compared with coal, to produce the same power?

I would like to take this occasion to read a few lines that Mr. Wirt, of Chicago, who sits alongside of me, has called my attention to. They were published in the English *Electrician*.

> "The Alchemist of old, as you're doubtless aware,
> Turned metals to gold by fasting and prayer;
> The Alchemist new, Forbes his name, has a plan
> For turning town *refuse to light* by a *dam!*"

Prof. Forbes: Mr. Hammer has asked me a very pertinent question as to the amount of house refuse we find is necessary to take the place of the five pounds of coal. I have a large number of experimental data to be guided by. I may tell you that in the old fashioned method building destructors it took 10 pounds of refuse to produce the effect of one pound of good Welsh coal. Now we have reduced that quantity down to about five or six pounds of refuse to be equivalent to one pound of coal; therefore, in answer to Mr. Hammer's question it would take about 30 pounds of house refuse to equal five pounds of coal.

Mr. T. C. Smith: I would say to the members of the association that a very common and familiar example of much the same process that Professor Forbes has outlined can be seen in the boiler end engines commonly used for hoisting purposes. Take a small five horse-power boiler, with pretty large storage capacity, and they will use that and drive an engine which will develop from 20 to 30 horse-power. The fire is kept going at the same steady rate all day long, and in the intervals of the hoisting, when the load is being lowered, the pressure will rise to 120 pounds. When the hoisting is being actually done the pressure will drop back to 100 or down to 80 pounds. Then the engine is at rest for awhile, but the boiler keeps on making steam and storing it. In this way we are enabled to do with a small boiler work that is far beyond its capacity. The same thing can be seen in nearly every elevator plant, where the boiler is much less in horse-power capacity than the pump which it drives. The same thing can be seen to a very much greater extent in railway power stations, where, in order to meet the demand upon the trolley, they can exert a much greater horse-power than is normally provided for by their equipment. The greatest doubt in my mind as to the success of this storage system is that identically the same thing was tried in the city of Boston, where a company was formed for the purpose of distributing power by hot water, called liquid steam, which simply meant water at a pressure and temperature corresponding to about 400 pounds, I believe. This water was carried through pipes, and when it was desired to use it in any building, the moment it escaped it became steam. The practical working of the plant was first rate. The thing collapsed, however, through an unexpected difficulty; and that was the tremendous and rapid destruction of the pipes from the continual use in them of the highly heated water.

How that would affect a plant of this kind, where you could make it from steel, I do not know. Perhaps Professor Forbes could give us some information on that point. The effect on the iron pipes, as used in the case cited, was to cause the abandonment of the city; and I understand the old material was sold recently.

Professor Forbes: I am obliged to Mr. Smith for his excellent remarks on this point. They are most appropriate. He has spoken about the hoists being practically worked on the same lines. I may mention that water storage, which I have also advocated, has been used similarly for hoists and for hydraulic accumulators by Lord Armstrong, very largely indeed.

Mr. Wirt: The fireless steam locomotive is also another example in point. We had these engines in service in Chicago for many years, during which they did good service, and were finally replaced by the cable line. These locomotives were of the ordinary type, but had larger steam boilers than usual. The boilers had no furnaces and were charged at one end with hot water under high pressure from an ordinary stationary steam boiler. The locomotive ran a round trip of six or eight miles, perhaps, and pulled very heavy cars and heavy loads, giving regular and satisfactory service, winter and summer. I was not present during the reading of the entire paper; and would like to know why the storage battery fails in comparison with steam storage; whether it is depreciation, lack of efficiency, or interest charges. It is pretty evident that there is an advantage in working dynamos at full power 24 hours a day, as well as working the engines. It is also evident that if storage batteries are used there is a saving on both engines and dynamos, which we do not get in the case of steam storage.

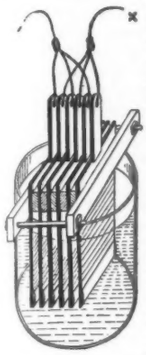
Prof. Forbes: I made a direct comparison between the cost of batteries and of the thermal storage system. The loss in connection with the storage battery includes all three of the items you named. Increased original expenditure in putting down storage batteries, which is far greater than the dynamos and machinery they replace, and also the great loss of efficiency—80 per cent. being the efficiency at which they work,

(*Continued on page* 50.)

Storage Cells for Amateurs.

C. L. WOOLLEY IN THE "SCIENTIFIC AMERICAN."

In the construction of storage cells on a small scale, the method of using uncoated lead plates merely roughened, afterward depending upon the forming process to create active material on the surface, gives good results, save that the forming process is exceedingly tedious.



Plates coated with a paste of red lead give better results, and that in a very much shorter time. The amateur, however, is usually beset by many difficulties in the matter of the coating of the plates, the paste, no matter how well dried, having a tendency to fall off as soon as the plates are immersed in the acid solution in the cells. The writer has, by means of a simple process, succeeded in preparing storage cells that have given for various experimental and domestic purposes exceedingly good results, during a period of a year or more, and are still in use. The plates, of any convenient size, may be either cast in wooden or iron moulds or cut from sheet lead; they should be sufficiently thick—one-eighth inch or more—to withstand possible bending or buckling as much as possible. A strip of sheet lead four or five inches long should be soldered to the top of each plate, from the upper end of which soldered copper connections may proceed. The copper is thus removed from the danger of corrosion from acid spray. Holes having a diameter of about one-half inch should be punched in each plate at regular intervals. The balance of both sides of each plate should be thoroughly roughened, either by drawing the tang of a file repeatedly across in various directions, or by the use of a punch with a roughened face. For coating the plates a stiff paste should be mixed of powdered red lead made up with a mixture of water two parts, sulphuric acid one part. The plates are to be thoroughly coated on both sides, and the holes in the plates well filled up. Each plate is then, while paste is moist, wrapped tightly in one or two layers of coarse muslin, and this is bound down firmly in place with cotton cord, passing around the plates at short intervals. The use of the cloth coverings makes success possible. The paste is held in position until, by the process of forming in the cells, it becomes sufficiently hard and adherent to remain in position on the plates, when, if they have not already been rotted off by the acid, the cloths may be removed.

The number of plates in a cell may be from a single pair to an indefinite number. Connections are made to alternate plates, one connection proceeding to plates Nos. 1, 3, 5, 7, etc., the other connection to plates Nos. 2, 4, 6, 8, etc.

When not more than six or eight plates in each cell are used, a convenient method of holding them in place is shown above. A series of wooden insulating strips are made, each being thoroughly baked and soaked in hot paraffine. Two heavier wooden bars on either side of the row of plates, drawn together at the ends by bolts, serve to hold the plates in position, each plate being separated from the one next to it by one of the insulating strips. The wooden bars should also be well soaked in paraffine. The bars are of such length that they extend across the top of the cell and sustain the row of plates and prevent their touching the bottom of the cell. A single cell when charged will give two volts. Each additional cell arranged in *series* will add 2 volts, as 4, 6, 8, etc. The charging current may be from a small dynamo or a primary battery, in which case a gravity or blue vitriol is to be preferred.

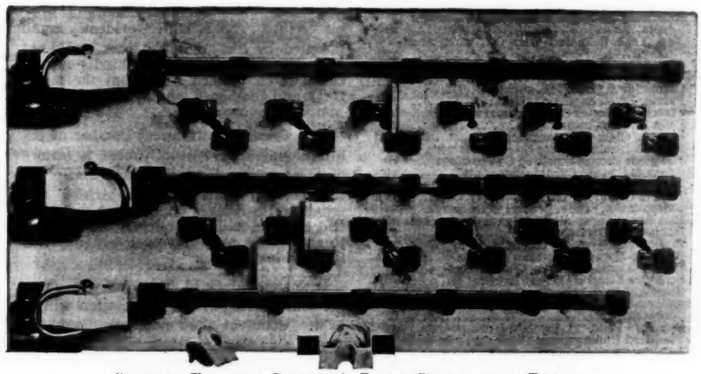
The electromotive force of charging current must exceed the sum of the storage cells by at least 10 per cent. For example, three cells gravity will charge a single cell of storage, five or six will charge two cells storage, eight or nine will charge three cells of storage, and so on.

The storage cells may be used very satisfactorily for operating small lamps, small fan or sewing machine motors, etc.

The first charging of a new storage cell is best accomplished by a series of bichromate cells, as Fuller or carbon, after which the gravities will charge very well. It will be found that up to a certain point the capacity of the storage cells will increase with each charge and discharge. The solution in the cells in which the plates are immersed is composed of water, nine parts, sulphuric acid (commercial), one part. After forming, always charge in the same direction and always discharge the cells through some form of resistance.

The Electric Circuit, of St. Louis.

The newly formed electric club of St. Louis, to be known in the future as the Electric Circuit, of St. Louis, held a meeting on February 21, at the Missouri Electric Light and Power Company's plant, Twentieth street and Lucas place. The following new members were elected: A. R. Derdier, A. R. Pike, W. S. Warren, George Bahret, John Dillon, Anson Murphy, C. S. Clark, C. W. Cook, F. C. Beardsley, Gus Fack, J. W. Mitchell, R. H. Cook, J. H. Burke, H. H. Beardsley, F. Krenning, W. S. Merkle, J. B. Price, L. Mathews and John T. Lynch.



GENERAL ELECTRIC COMPANY'S PANEL DISTRIBUTION BOARD.

Here are the officers elected for the ensuing year: President, F. C. Beardsley; vice-president, Gus Fack; secretary, W. S. Merkle; treasurer, H. H. Beardsley; sergeant-at-arms, Anson Murphy.

A New Electric Drill.

An exhibition of the operation of the Joncs rotary electric mining drill was recently given in Salt Lake City. Thrown into place, facing a large boulder of dolomite lime and quartz, the drill started with uniform and steady speed. The bit used was a 1⅞ inch, taking out a core of one inch. A noticeable feature was the ease and facility with which all the details were handled by the operator. This is a matter that commends it highly, and the work is done without the least jar or hitch. Its simplicity is most apparent, even to those who have not had experience with other apparatus for mining work. There can be no doubt but this drill will revolutionize the work in this line, exacting less labor, and the rapidity with which it drills makes it one of the foremost and most valuable additions to machinery that has been introduced to the mining fraternity.

The annual meeting of the Empire State Telephone and Telegraph Company was held at Auburn, N. Y., February 20. The directors elected were Henry L. Storke, Dixon B. Parker, George Underwood, Dexter B. Smith, James Seymour, Jr., Fred. E. Storke and Fred. I. Allen. The officers elected were: H. L. Storke, president; Dexter A. Smith, vice-president and general manager; George Underwood, secretary; James Seymour, Jr., treasurer; George A. Paddock, assistant general manager; Chas. A. Weeks, auditor.

Panel Distribution Board.

An improved method for controlling the distribution of the electrical current in buildings, which could take the place of a number of cumbersome porcelain cut-outs, has long formed the desire of construction and wiring men. For the past six years they have continued, perforce, the use of the tree system and the porcelain cut-outs; and the desired improvement seemed beyond the conception of inventive minds, or not of sufficient importance to merit deep attention. An aggregation of separate cut-outs enclosed in a cupboard, and hidden from sight in some secluded portion of the building, hard to get at, and when gotten at, difficult to manipulate, has long been considered antiquated, but the hour of its supersession has only just sounded.

It has remained for the General Electric Company to invent a system which not only does away with the unprepossessing, ponderous, porcelain link or plug cut-outs when used as distribution centers for a number of circuits, but substitutes what is really a handsome device fulfilling all the functions of its unwieldy congenor.

The cut shows one of these panel distribution boards, arranged for the distribution of current for 120 lights from a three wire main service over 12 circuits on a two wire system. The panel itself is a polished white marble slab 10 inches by 20 inches. The main wires are brought to the lugs, and are continued along the front of the panel in the shape of flat hard drawn copper rods. Upon these are mounted stiff spring copper slips. Each main wire and each side of each branch circuit is protected by a fuse enclosed in a porcelain box of novel design, from the sides of which project short flat blades of copper. By means of these blades, the fuse carrier is inserted in position and is there securely held by the copper clips. A perfect frictional contact is thus insured.

The construction of the fuse carrier is peculiar. It is literally a box with three sides straight and one arched, having a partition in the center between the two terminals, to which the fuse is fastened, as shown in the cut. When compared with the time-honored screw plug or ordinary fuse its advantages are so obvious that practical men cannot fail to recognize and appreciate them. No short circuit can possibly occur between the terminals; the arc cannot follow the fused metal and burn them out; the molten metal cannot be blown out, the mica-lined cover preventing this; the area of contact is considerably greater than in the case of the screw fusible plug, and in replacing a blown fuse the wire man is not exposed to any danger from a sudden blow of the new fuse. A fuse carrier can be removed and the fuse replaced on the spot, or a fresh one can be inserted, and that in which the fuse has blown can be carried away and the fuse replaced at the repair shop or the works. The removal of a fuse carrier, with fuse, of course, disconnects the circuits. The porcelain carriers are practically indestructible by the current. They are made from the best white vitreous porcelain from the porcelain factory of the General Electric Company.

The fuse carriers protecting the main wires are furnished with a small brass ring to facilitate their removal—the smaller carriers are more easily drawn out and the ring is unnecessary. All connections are made upon the face of the panel. This disposition enables it to be fastened against a wall or to be sunk in a recess bringing its surface flush with the wall, a glass door hinged to a polished wooden frame serving to protect it from the merely inquisitive. This style of panel distribution board can be made up in almost any combination of circuits, and can be placed almost anywhere in any building, its handsome appearance detracting in no wise from any surrounding decoration. The New Waldorf Hotel is the first building to be fully equipped with these panels, no less than 3,500 lights being distributed from a number of them.

There Were Sounds of Melody by Wire.

On Monday evening, February 27, the Long Distance Telephone Company gave another of its delightful receptions. This time it was a musicale, and the many invited guests, both ladies and gentlemen, drank in sweet harmonies. Those who furnished the musical feast were Miss Minnie Wetzler, Mr. Plunkett Green and Mr. Hermann Wetzler. Miss Wetzler played in her usual masterful manner, and charmed her audience by the brilliancy and delicacy of her execution. Mr. Plunkett Green sang several selections, and his rich baritone voice was distinctly heard by Mr. Theodore Thomas, who was seated at the Chicago end of the wire at No. 105 Quincy street. Mr. Wetzler then played a delicate little composition of his own called "Summer Morning in the Woods," and it really seemed as if the room was temporarily converted into a miniature forest, and the rippling of the waters of the little brooks and the warbling of the birds could be almost heard. "Marching Through Georgia" and the "Marseillaise" were played into the transmitter in Chicago, and were listened to attentively by those present. The service was perfect.

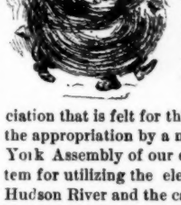
After the musical part of the programme came refreshments, which were discussed by the appreciative audience with much relish.

Among the many present were Mr. and Mrs. E. J. Hall, Jr., Mr. and Mrs. J. J. Carty, Messrs. F. A. Pickernell, Joseph Wetzler, Julian A. Moses, Prof. Alexander Lambert, Geo. M. Phelps, C. R. Bangs and H. G. Bates.

Stand Away From a Loaded Wire.

(*From Once a Week.*)

It is quite the fashion for some journals in this and other cities to appropriate our pictures, our reading matter and our ideas. We have become accustomed to this and are not surprised when it occurs. The latest evidence of the widespread appreciation that is felt for this journal is seen in the appropriation by a member of the New York Assembly of our copper fastened system for utilizing the electric trolley on the Hudson River and the canals! If our lawmakers are to co-operate with the literary brigands who have been for months looting our pages, it is high time for us to appeal to the Supreme Court. An editor who would filch an idea from a contemporary without proper credit ought to be exposed; but the lawmaker who would appropriate and patent a suggestion made with characteristic generosity by *Once a Week*, for the benefit of the entire human race, is worthy of a seat in the electric chair. Our artist has cleverly indicated what is liable to happen to the next man who tampers with one of the many wires charged with cerebral electricity that lead into this office.



There is talk of extending the tracks of the Inter-State electric road from Attleboro, Mass., through Norton and Easton to Brockton.

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CONTENTS.

	PAGE
Views, News and Interviews	43
Edward Ambler Armstrong	43
The St. Louis Convention	43
Storage Cells for Amateurs	47
The Electric Circuit, of St. Louis	47
A New Electric Drill	47
Panel Distribution Board	47
There Were Sounds of Melody by Wire	47
Stand Away from a Loaded Wire	47
Convention Comment	48
Some Rapid Work Expected at the World's Fair	48
Cut-Outs in Central Stations	48
Flashes of Light Out of the Darkness	48
Correspondence:	
Our Boston Letter	49
Our Chicago Letter	49
Carborundum and How it is Made	49
Personal	49
Our Canadian Letter	49
Letters from a Laboratory	49
The Beacon Lamp Case	53
Gifts Worthily Bestowed	54
Motors for Alternating Currents	54
Magnetic Pulleys	54
On Her Dignity	54
Electric Railway and Power Notes	54
Advance Information	55
Kindred Interests	56
Progress of Telephony and Telegraphy	56
A Traveling Telephone	56
Dark Times in Bucksport	56
Electrical Patents	xii

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE.
American Electrical Works, insulated wire	i
Ansonia Brass & Copper Co., wire	xxii
Armington & Sims, engines	xxii
Babcock & Wilcox Co., boilers	xxii
Beacon Vacuum Pump Co., inc. lamps	i
Brush Electric Co., apparatus	xxi
Campbell Electrical Supply Co., insulating tape	i
Crocker-Wheeler Motor Co., motors	i
Day's Kerite, insulated wire	i
Dwight Slate Machine Co.	xxii
Eastern Electric Cable Co., insulated wire	xxii
Eddy Electric Mfg. Co., motors	i
Faraday Carbon Co., carbons	xxii
Hampson & Co., E. F., engines	xxii
Jewell Belting Co., belts	xxii
Massachusetts Chemical Co., insullac	i
Mather Electrical Co., power generators	i
Moore, Alfred F., wire	xxii
Noye Mfg. Co., John T., engines	xxii
Okonite Co., insulated wire	i, ii & xxii
Otis Bros. & Co., elevators	xxii
Paine & Ladd, patent attorneys	i
Rhode Island Tool Co., tools	xxii
Riker Electric Motor Co., motors, dynamos	i
Simplex Electrical Co., insulated wire	i
Waterhouse, Gamble & Co., arc lamps	i
Westinghouse Electric & Mfg. Co., electrical apparatus	xxxi
Weston Engine Co., engines	i
Wilmot & Hobbs Mfg. Co., bell gongs	xxii

INSIDE PAGES.

Alexander, Barney & Chapin, sal ammoniac	vi
Allis & Co., Edward P., engines	xiv
American Bell Telephone Co.	v & 60
American Fluoride Co., fluoride	xiv
Arbuckle, F. P.	vii
Baker & Co., platinum	xii
Ball Engine Co., engines	xii
Barrett, John A., electrical engineer	xii
Berlin Iron Bridge Co., iron roofs and buildings	xviii
Bickford & Francis Belting Co., belts	xi
Bishop Gutta Percha Co., insulated wire	xi
Blaisdell & Co., tools	xiv
Boston Gear Works, gears	xi
Brill Co., J. G., tramway cars	viii
Brixey, W. R., wire and cables	x
Brown Electric Co., electrical supplies	xviii
Bryant Electric Co., switches and sockets	x
Buckeye Engine Co., engines	xviii
Butler Hard Rubber Co., hard rubber	xii
Carpenter Enamel Rheostat Co., rheostats	vii
Case Engine Co., J. T., steam engines	x
Central Electric Co., supplies	vii
Chicago, Milwaukee & St. Paul Railway Co.	xviii
Church & Sleight, tools and supplies	xviii
Clark Electric Co., arc lighting	viii
Conover Mfg. Co., condensers	xiv
Consolidated Electric Manufacturing Co., dynamos	iii
Cowles Electric Smelting & Aluminum Co., aluminum	60
Cutter Electrical & Mfg. Co., reflector shade	x & xvii
Cutter, George, electrical supplies	x
Davidson Ventilating Fan Co.	xvii
Dewey Electric Heating Co., electric heaters	vii
Dixon Crucible Co., belt dressing	viii
Dunderdale, F. C.	xiii
Edison Decorative and Miniature Lamp Department, incandescent lamps	60
Electric Secret Service Co., cut-outs	xiii
Electrical and Mechanical Engineering and Trading Co., contractors	vii
Electro-Light Engraving Co., engraving	xii
Empire China Works, porcelain specialties	xiii
Falls Rivet & Machine Co., friction clutches	v
Fort Wayne Electric Co., Wood arc lamps	v
Garvin Machine Co., tools	xiv
General Electric Co., inc. lamps	ix & xv
General Incandescent Arc Light Co., arc lamps	iv
Gleason Manufacturing Co., E. P., electrical appliances	viii
Goodyear Hard Rubber Co., hard rubber	xii
Greeley & Co., The E. S., supplies	vii
Harrisburg Foundry & Machine Works, engines	xviii
Hart & Hegeman Mfg. Co., switches	60
Holmes, Booth & Haydens, insulated wire	viii
Hotel Vernon	xvii
Hulbert Fence and Wire Co.	xiv
Indepeudent, The	60
Interior Conduit and Insulation Co., fan and motors	xiv
Johns Mfg. Co., H. W., vulcabeston	xiii
Lake Co., J. H. & D., pulleys	viii
Leclanche Battery Co., batteries	xi
Lehigh Valley Creosoting Co., creosoted lumber	60
Leffel & Co., James, water wheels	vii
Marshall, Wm., condensers	xii
May Bros.	xii
National Electric Mfg. Co., dynamo electric machinery	xviii
New England Butt Co., braiding machinery	xiii
New Jersey Lamp & Bronze Works, electric and gas fixtures	xi
Newton Rubber Co., hard rubber	x
New York Belting and Packing Co., rubber belts	xvii
New York Insulated Wire Co., wires and cables	xiii
Onondaga Dynamo Co., electrical apparatus	xi
Ostrander & Co., W. R., supplies	xiii
Palmer Bros., engine castings	60
Partrick & Carter Co., electrical supplies	xii
Penn Life Co., insurance	60
Phœnix Glass Co., glass globes	viii
Phillips Insulated Wire Co., electric wire	vi
Phosphor Bronze Smelting Co., castings	vii
Queen & Co., electrical instruments	xii
Railway Equipment Co., elec. r'y supplies	viii
Reed & Co., F. E., lathes	xviii
Ridlon & Co., Frank, general machinery	xviii
Ries Electric Specialty Co., regulating socket	xiii
Robinson & Orr, steel rails	vii
Rosenbaum, Wm. A., patent attorney	xii
Royce & Marsan, electrical supplies	xvii
Samson Cordage Works, braided cord	x
Schuyler Electric Co., arc lighting	viii
Shawmut Fuse Wire Co., fuse wire	xiv
Shoemaker, Homer, attorney and counsellor-at-law	60
Standard Paint Co., insulating compounds	xiv
Standard Underground Cable Co., wire and cables	iv
Stanley Electric Mfg. Co., transformers	xi
Stevens & Morris, engravers	vii
Stocking, E. B., patent attorney	xii
Swan & Lane, contractors	xviii
Tregoning, John, books	60
Tyndall, Wm. D., attorney	xii
Underwood Mfg. Co., cotton leather belting	iii
Walworth Mfg. Co., trolley poles	iii
Washburn & Moen Mfg. Co., wire	x
Western Electric Co., supplies	vii
Western Electrical Supply Co., electrical supplies	vi
Westinghouse Electric & Mfg. Co., incandescent lamps	xix
Wilson, Fremont, electrician	xii

The Hon. J. M. Rusk, the late Secretary of Agriculture, in an article on "American Farming a Hundred Years Hence," in the *North American Review* for March, says: "In my opinion, the changes in our methods of farming in the future will be brought about by a wide knowledge and application of scientific principles. I do not think it probable that farm implements will be improved very much, although doubtless on the larger farms means will be devised to perform certain operations by electricity or steam."

The recent heavy fall of snow has been a source of great annoyance to those in this city who have had occasion to use the surface roads. Many of the trips on some of the lines have been delayed so that the cars have been put behind as much as two hours. The poor overworked horses, beaten and yelled at by the drivers, strain every nerve in the attempt to keep up the terribly hard work. Many of them have failed, and in several instances the poor dumb brutes have died in consequence of the overexertion. Need we mention the remedy? It is obvious. Any person with humane instincts will not need even a hint. Let us emancipate the poor unfortunate car horse.

CONVENTION COMMENT.

St. Louis added another laurel to her well-known wreath of hospitality.

President Ayer is to be congratulated over his ability as a presiding officer. He was ever pleasant, alert and ready.

There was probably 400 persons in attendance, outside of St. Louis. The electrical people of the bridge city were out in full force, and aided greatly in the success of the meeting.

The alternating current received a good deal of attention at the St. Louis Convention. The future before this method of distributing energy is a vast one, and is being rapidly explored by many able minds.

The new president of the Association, Judge Armstrong, of New Jersey, has been Speaker of the House, and is admirably fitted for the office to which he was elected. The Judge is an eloquent speaker, and is greatly interested in electrical progress.

There were a number of particularly excellent papers, and they were nearly all quite generally discussed. Prof. Geo. Forbes, of London, and Prof. Edward Weston, of Newark, are two eminent electricians whose technical opinions were in constant request.

President Ayer, Mayor Noonan, the Electric Club, the Electrical Exchange and citizens without number exerted themselves to see that every visitor was made to enjoy the occasion. The lady visitors in particular were most kindly received by the ladies of St. Louis.

Nikola Tesla received quite an ovation in the lobby of the exposition building after his lecture, and although evidently much fatigued by his evening's work, could not but appreciate and enjoy the kindly expressions which greeted him from the many ladies and gentlemen who remained to meet him.

The absence of the great number of exhibits, which have usually been a feature of these conventions, was particularly noticeable, but those who did exhibit can felicitate themselves on the fact that they had the field and consequently all they had to show was much more closely inquired into and inspected.

It was not decided just when and where the next meeting of the Association will be held. Some of the members thought a meeting at Chicago, six months from now, so the delegates could visit the World's Fair, would be a good thing; others favored a yearly meeting. It was finally decided to leave the question in the hands of the executive committee.

The delegates from St. Louis and the pilgrims from the inauguration at Washington returned about the same time. A Tammany tiger and an electric light man walked up Cortlandt street, arm in arm, and made a handsome combination. The witticism which runs to the effect that no one needs a holiday so much as the man who has just had one is now *apropos*.

There was much suppressed interest in the incandescent lamp question that only required a touch to unloosen. The little passage at arms between Mr. T. Carpenter Smith and Dr. Louis Bell evidently convinced President Ayer that the discussion would very likely become too acrimonious for the dignity of the Convention, and he very skillfully shunted it.

Much of the success of the St. Louis Convention and the present prosperous condition of the National Electric Light Association may be justly attributed to the intelligent efforts and energetic labors of Mr. George F. Porter, the secretary of the Association. Mr. Porter is the right man in the right place, and it is hoped that he may continue in his good work.

On Friday, the visitors were treated to a rare entertainment, consisting of rides through the parks and boulevards of St. Louis, and a magnificent lunch at the Jockey Club, where music, flowers and eloquence added to the enjoyment of all. The lunch proved to be a veritable feast. All of the 200 visitors who remained over for Friday's entertainment congratulated themselves, and will be envied by the less fortunate ones who were compelled to leave earlier.

CUT-OUTS IN CENTRAL STATIONS.

It seems that the frequent "fireworks" that we hear of in connection with a broken wire carrying a heavy current could be obviated by the use of a central station cut-out. That they are not in general use must be due to some apparently valid cause. It is not easy to determine conclusively what this primary cause is, and there are great differences of opinion regarding the use of cut-outs. Is it that they have been tried and found wanting, or is there a prejudice against them? Let the practical central station men speak.

SOME RAPID WORK EXPECTED AT THE WORLD'S FAIR.

The telegraphic arrangements at the World's Fair will be on a par with the other large undertakings for the convenience of the people and the press. It is expected that on eventful days, when the demands of the newspapers will be heaviest, the Western Union Company alone expect to be able to handle 40,000 words for afternoon journals. At a quick glance this number of words does not seem a very great quantity of matter, but let us stop and think a bit. One full page of the ELECTRICAL REVIEW contains, without headings, about 3,000 words. These 40,000 words would, therefore, fill over 13 pages of this journal. When it is declared that these words are to be transmitted in time for the afternoon papers, we must remember that the afternoon papers go to press about 1 o'clock, and the time allowed for reporting, transmitting, receiving and composing is only that between the occurrence of the event in the morning and 1 o'clock in the afternoon. Another point to be kept in sight is, that it would take one person writing at the rapid rate of 40 words per minute, about 17 hours steady work to transcribe 40,000 words. The figures seem a little larger when we come to analyze them.

FLASHES OF LIGHT OUT OF THE DARKNESS.

On Wednesday evening, March 1, Mr. Nikola Tesla delivered, in the music hall of St. Louis, his brilliant lecture on some of his recent discoveries of the effects of currents from alternating generators of high frequency.

As early as 7 o'clock the steps to the music hall were thronged with people; tickets of admission were at a premium, and when the lecture commenced standing room in the house could not be obtained.

On the stage could be seen a white temporary work-bench, upon which rested his apparatus, while on a smaller table near at hand was an assortment of his lamps. Two large incandescent light chandeliers furnished the stage illumination and at the rear was a large floral piece with the words "St. Louis Electrical Exchange, 1893" worked in white carnations with a border of American Beauties. Numerous incandescent lamps shone from the mass of flowers, and in the center was a circle of bright red carnations, bordering a centerpiece of white pinks with the emblem of the association, $C \begin{matrix} E \\ — \\ R \end{matrix}$.

The whole produced a striking and tasty effect as a background for the lecturer of the evening.

At 8.30 the officers of the National Electric Light Association took their places on the stage. A few seconds later President James I. Ayer appeared, followed by Mr. Tesla, whose face is familiar to all electricians and readers of the electrical journals.

As an introduction, Mr. Tesla dwelt on the relations of light to life, and told of the many beauties which would be lost to us were it not for light.

With continuous currents of very high voltage and high frequency alternating currents he showed some remarkable phenomena. Darkness was, of course, necessary in order to exhibit these experiments and the lights were, therefore, turned off. A hushed silence prevailed and the weirdness of the experiments lent an additional charm to the surroundings.

Experiment followed experiment until the audience were in a maze of admiration. Unfortunately the hall was so large that the lecturer could not be heard very well, but those whose who did hear were well rewarded for their attention.

After the lecture followed a brief reception and many were eager for an introduction to the lecturer.

CORRESPONDENCE.

OUR BOSTON LETTER.

A Company organized in Portland, Me., propose building a large electric light plant on the Connecticut river during the coming spring, and will utilize the Fifteen Mile Falls for furnishing power. They propose to furnish lights to towns on both sides of the river.

The Underwood Manufacturing Company, of Tolland, Conn., have cancelled their contract with the Engineering Equipment Company, of 143 Liberty street, who have acted for some time past as their New York agents, and are now doing business under their own name, with headquarters at 38 Cortlandt street.

The Brockton, Mass., Street Railway Company have made all arrangements for the extension of their lines so as to include East and West Bridgewater and Bridgewater. Their tracks now connect Brockton with Whitman, Avon, Randolph and Holbrook, and work on the extension will begin early in the spring.

A New Electric Derrick having a lifting capacity of about eight tons, has recently been put on the market which, it is claimed, is more compact, economical and convenient to operate than anything yet devised in this line. Power is supplied by a No. 12 railway motor, geared down to give a rope speed of from 45 to 70 feet per minute under a load of 3,500 pounds.

The Hartford, Conn., Electric Light Company are increasing their power plant at Tarriffville for the transmission of power from the Falls, and are now putting in two additional 275 horse-power generators and two 400 light incandescent dynamos. A high tension current is transmitted a distance of 10 miles and utilized at their central station in Hartford.

The Fight which has been carried on for the past three years between the Lynn and Boston Street Railway Company and the authorities of Beverly, Mass., has at last been settled, and, as usual, the trolley comes out ahead. At a meeting of the selectmen, held March 2, it was agreed to allow the extension of the overhead system through the town on the same conditions as those adopted in Salem, and work will be pushed ahead as soon as the ground is open.

Careful Experiments with porous wood board paper have demonstrated that when such material is saturated with insullac its resistance to electrical pressure is very nearly equal to that of hard rubber. It is unaffected either by oil, water, or a high degree of temperature. These facts are of great suggestiveness regarding coil structure and insulation, and authorities consider that this new feature of insulation will increase machine capacity 30 to 40 per cent.

The Boston and Maine Railroad Company have decided to equip the Crescent Beach branch of their line with electric motive power, and the first locomotive for this purpose has been built and is in practical operation in the yards of the General Electric Company at Lynn, Mass. The overhead trolley system will be adopted and the construction work is now under way. It will probably be finished within the next 60 days, and the first steps towards the practical utilization of electricity by steam railroads for the handling of their freight and passenger business will have been taken.

The Street Car System of Tallahassee, Fla., is probably the only one in this country which could not be benefited by the introduction of the "trolley." In some respects this "system" is unique, and stands (it seldom moves) as a landmark on the road of progress. The rolling stock consists of one car, which is operated by "a colored man and a mule," both of whom, we are told, live only to accommodate the public. If the car happens to be going one way and the prospective passenger wishes to go in the opposite direction, all he has to do is to mention the fact, and the man and the mule promptly change ends and accommodate him. What would happen in the event of two passengers, with opposite destinations, wishing to use the line at the same time we are not prepared to say, but it is fair to presume that the railroad company would remain neutral.

The W. S. Hill Electric Company, of this city, have recently turned out a machine which it is safe to say will soon make itself felt in telephone and telegraph circles, and probably lead to radical changes in the manner of operating their central stations. The machine in question is a combined motor and generator and was made especially for the New England Telephone & Telegraph Company, for use in their central station in this city. It was built on the regular lines of the Hill one horse-power motor, with the exception that the armature is double-wound to two commutators, one at either end. It has a capacity of one horse-power running at 1,000 revolutions, from a 110-volt circuit, and generates a secondary current of 20 amperes and eight volts potential. It is used to charge two storage battery cells which act as regulators, and control any vibrations or fluctuations of the current which would interfere with the working of the exchange. Mr. Hill designed and built the first one of these machines as far back as 1884, and the one now in use by the New England Telephone & Telegraph Company was built from the same model. The telephone people have submitted it to all manner of tests and found it to work to their entire satisfaction. When it is considered that one of these machines will do the entire work of supplying current for a large exchange, and do away with the bulky and expensive batteries now in use, its general adoption would seem to be a matter of a short time only.

It seems that Mayor Matthews of Boston is still after the gas and electric light companies with a sharp stick, and the investigations which he has been carrying on for some time past, and the estimates with which he has been furnished as to the cost of constructing and maintaining a municipal plant, have evidently convinced him that the city is paying too much for lighting. He has carried the matter before the legislature and has given them food for thought in the following measures, which he has petitioned that body to act upon.

1. An act authorizing the Board of Aldermen of Boston to prescribe the payment of certain annual fees as a condition upon which all locations in the streets of said city for lighting purposes, heretofore or hereafter granted, shall be used and enjoyed.
2. An act compelling all gas and electric light companies doing business in said city to pay the said city a tax at the general rate for the year upon the amount of notes, bonds or other obligations, and not specifically returned to any local board of assessors in the Commonwealth.
3. An act compelling every gas and electric light company doing business in the said city to furnish gas and electricity to said city for lighting its streets and public buildings at the reasonable cost to manufacture the same, the said reasonable cost to be determined by the board of gas commissioners upon application by the mayor of said city.
4. An act authorizing the city council of said city to prescribe by ordinance a sum which shall be paid by individuals and corporations receiving authority to open the streets of said city for laying pipes and wires or making repairs, said charge to be a sum in gross for each excavation, or a sum proportionate to the length of excavation.
5. An act repealing so much of chapter 370, acts of 1891, as prohibits said city from making gas and electricity for lighting its streets, parks and public buildings.
6. An act amending chapter 350, acts of 1888, so that applications to the board of gas commissioners for the revision of rates or contracts may be made by the said city as well as by the gas companies.
7. A law applying the foregoing principles to all cities and towns within the Commonwealth.

Bills were submitted to carry out each of these specifications. H. G. T.

Boston, March 4.

OUR CHICAGO LETTER.

George Cutter has sold his shop at 313 South Canal street to H. H. Cutler and E. W. Hammer so as to devote his whole time to his own pet specialties.

Alexander Van Babo, representative of Siemens & Halske, Germany, has removed his office from Monadnock building to 812 Bort building, Quincy street.

The Cushman Telephone Syndicate, of Chicago, was licensed to incorporate Friday, February 10, to manufacture and sell telephones outright under a patent which they have pending.

Gustave Monrath, who will be remembered by our readers for his work at Marseilles and Chicago, has now opened an office at 1602 Monadnock building, and will supervise the construction of electric light and power plants.

Prof. Moses G. G. Farmer, who is now residing in this city, is preparing an exhibit for the Electricity Building which will arouse the interests of electricians. Among his exhibits he will display a model of an electric road built by him in 1847; also a system of incandescent lighting which he fitted up in his residence at Salem, Mass., in 1859.

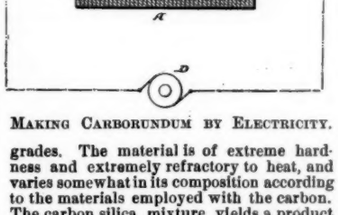
The Illinois Electrical Forging Company have just been incorporated with a capital of $2,000,000. Walter G. Campbell, of San Francisco, is president; L. D. Kneeland, vice-president, and John P. Skinner, of New York, secretary and treasurer. The offices will be in the Title and Trust building, 100 Washington street, room 401, Chicago, Ill. This company will do all kinds of electrical forging, smelting and welding, and will be located at West Pullman, Ill. Mr. Campbell, the president, has been interested for the past few years in mining in the far West and has a vast experience with the various ores. Mr. Kneeland, the vice-president, is also vice-president of the West Pullman Company and a large stockholder.

Chicago, March 4. M. J. B.

Application has been made in behalf of the defendant in the old case of the United States *vs.* the Bell Telephone Company to Judge Nelson in the United States Circuit Court for an extension of time to allow additional testimony to be taken before the commissioner. The application was granted and six months extra time allowed.

Carborundum and How It is Made.

A recent patent issued to Edward G. Acheson, of Monongahela City, Pa., describes the method of making carborundum, a very hard abrasive material which has lately appeared upon the market. The material is so hard that it can be used to polish diamonds and glass. The material is a composition of silicon and carbon, with traces of alumina, magnesia, lime and oxygen. In making it an electric furnace is resorted to by which a very high heat is attained. A diagrammatic apparatus is illustrated in the accompanying engraving, wherein is shown a fire brick containing vessel which is filled with 50 per cent. of pure carbon, preferable such as gas coke carbon as pure as can be obtained; 25 per cent. of silica or silicate of alumina, and 25 per cent. of salt, the parts being taken by weight. These materials are finely ground and intimately commingled and placed in the receiver across which extend two electrodes for leading into the mixture a current from a dynamo electric machine. As the mixture is of a very high resistance, the space between the electrodes is at starting primed with graphite or some other fairly good conductor. The high heat developed by the electric current fuses the material, the salt acting as a flux. The material which forms the carborundum is found in a zone about the line joining the two electrodes. It is separated from the rest of the mass, freed from the graphite, broken into small pieces, boiled and washed, then dried by heat, and pulverized in a stamping machine, and then separated into crystals of different



MAKING CARBORUNDUM BY ELECTRICITY.

grades. The material is of extreme hardness and extremely refractory to heat, and varies somewhat in its composition according to the materials employed with the carbon. The carbon silica mixture yields a product giving the following analysis: Si–69.19; $Al_2O_3+Fe_2O_3$–0.38; CaO–0.19; MgO–0.06; C–29.71; O–0.47=100.00. The mixture of carbon and clay gives the following analysis: C–30.09; Si–60.51; $Al_2O_3Fe_2O_3$–4.78; CaO–0.17; MgO–0.18; O–4.27=100.00.

PERSONAL.

Dr. Walther O. Lobach, electrical engineer and member of the Imperial German Commission at the World's Fair, passed through New York last week on his way to Chicago.

United States Senator-elect Smith having resigned as Electrical Subway Commissioner, Gov. Werts, of New Jersey, has nominated State Treasurer George R. Gray to fill the office.

OUR CANADIAN LETTER.

Aylmer, Que.—The council is considering a proposal to have its streets lighted by electricity.

Preston, Ont.—The Galt and Preston Street Railway Company will apply to the town council for permission to build and operate an electric street railway in this town.

Kaiso, B. C.—Application will be made to the local legislature for an act to incorporate a company to operate a tramway and to maintain an electric lighting system at this place.

St. Catharines, Ont.—The St. Catharines, Merriton and Thorold Street Railway Company desire to secure a supply of ties, rails, poles and stringers for street railway construction.

Victoria, B. C.—An application will be made by a local company at the next session of the legislature to incorporate a company to construct and operate a motor line from Victoria through Mount Tolmie Park to Cordova Bay, a distance of six miles.

Montreal, Que.—The Montreal Street Railway Company have ordered 25 new cars from Belleville, Ont., to be delivered on May 24. The company have 115 new electric cars now running, and they expect to have 400 electric cars running in the streets of Montreal within two years.

Montreal, February 25. J. A. C.

LETTERS FROM A LABORATORY.—XXXV.

BY JULIAN A. MOSES.

A man once applied to Peter Paul Reubens for work.

"What can you do?" said the eminent artist.

"I can paint."

"Very well, sit down and paint me that figure of the Virgin."

"I cannot paint figures; I can only paint backgrounds," said the man.

"Do you imagine for an instant that I would let you attempt a background of any of my pictures."

"But a background is a minor detail," expostulated the aspiring applicant.

"There is no such thing as a minor detail in a picture," exclaimed the painter, rather irritated. "It is one grand whole, and the most prominent parts owe their distinctiveness to the background, which, were it inharmonious, would spoil the entire work. He that can paint a background can paint a picture,"

The man left, impressed with the idea that there is nothing which is unimportant.

So it is to this day; no important work can be accomplished without a due appreciation of the so-called minor details.

If the experimenter is in such a position that he is enabled to employ intelligent help to assist him at his work, a suitable set of rules laid out for their conduct will no doubt prove of value for the furtherance of whatever may be in process of construction or operation. There are many experimenters who are averse to allowing anybody other than themselves to have anything to do with their affairs. They argue that two minds cannot run in the same channel, and that what one attempts he should carry out to the end, without any interference by outsiders. All great inventors and experimenters have, to a certain extent, carried out this line of argument, but in numerous instances the "minor details" have been left to hands perhaps more practical. Nevertheless, one man cannot do all the work in a large laboratory, and if he is in charge, the others under him should be so thoroughly trained, that, if thorough and systematic work is desired, whatever the one in charge orders, he knows will be carried out to the letter. The entire set of workers in the laboratory should work in unison. In one of the largest electrical works in this country, if any one of its minor employés is idle, due to his having finished his allotted work in a shorter time than that allowed, he must remain idle, and on no account will he be allowed to conduct any personal experimenting. The result of this system is that the chief electrician or head of the department knows at a glance all about the work that is being done by each and every man under him.

It may be claimed that this system destroys inventive talent and cuts short any original investigations, which would perhaps be to the advantage of him who has charge of the work in hand. These objections are just, but it must be remembered that this is a part of a complete system, and it is a question whether under the circumstances it could be bettered.

A few rules that are the outcome of a long experience in practical laboratory service will no doubt prove valuable.

Keep everything clean; cleanliness is a close relation to success, while disorder is the parent of failure.

Let everything have its individual place with due regard to its location as one of a class. "Parallelism" is no more order than the placing of the pages in a book with no regard to their sequence would make a readable volume. True, if one has the bump of locality enormously developed there is no need for order. Such people are, however, rare.

If anything is removed from its place, don't leave it anywhere else. Return it when you are done with it.

If any piece of apparatus has been broken, make a note of it, and substitute other or a new piece in its place.

Insist that no one shall interfere with any piece of work with which he is not directly concerned.

Take all precautions against fire and never throw a lighted match or anything liable to spontaneous combustion where it might be liable to cause some damage.

Put all your attention on the work in hand; remember, things done by halves are never done right.

Handle things carefully; haste produces disaster, while speed combined with accuracy and care, brings good results.

Keep an accurate record of all operations, where they are important, sign them and have your signature duly witnessed.

THE ST. LOUIS CONVENTION.

(*Continued from page 46.*)

there being a loss of 20 per cent. of coal; and also the depreciation account, which I think every one must admit is about 12 per cent. per annum. I have installed numerous storage batteries, but have never done so in a central station. I have done my best to try to find an economy in them, and if it were feasible, would have recommended them to central stations; but I have never found that batteries introduced in central stations would be a large economy. I know there are others who hold different views, but my experience leads me to the belief expressed. Storage batteries have their appropriate places, and I would like to see them much more used than at present in this country. There are a number of storage batteries that are available, and yet no one seems to work at them here. I have been told that it has been a question of patents, but this is hardly a reason, for some of the best batteries are founded on the Plante system, and that is open to the whole world. Litigation is also said to be the cause of the failure of a more general use of storage batteries. I regret, exceedingly, that they have not been adopted in their appropriate places in this country.

Mr. Stillwell: I want to say a few words in regard to the saving being effected at an early or late step in the process of transforming the potential energy of coal into light or power for sale. It seems to me that we should bring out the fact that a great deal depends upon the relative length of those steps. The central station men who is paying for energy in the form of coal and selling it in the form of light is losing various amounts at each step of the process, but up to the present time he is losing far more before it gets to the dynamo than he is after he leaves the dynamo. I have made a few figures to illustrate this. Suppose we have a thousand horse-power potential in the coal which we are burning under our boilers. I think the best figures which steam engineers will claim for the proportion of that coal or energy which they will deliver in the form of mechanical power to the dynamos in a station that is continuously operating will be about 10 per cent. Now, if we apply Professor Forbes' figures obtained from records at the Kensington station, we will find that under the variable load he loses about three per cent. of that; and it is this amount of the energy, which is really a very large amount at that stage, which this scheme of Mr. Halpin's proposes to economize. Of the seven per cent., that at the Kensington station, we will assume, is delivered to the dynamos, I think it can be demonstrated that the dynamos, the distributing circuits, under a properly arranged system, will deliver to the terminals or lamps about eight per cent. of five and $\frac{6}{10}$ per cent. of the initial energy of our coal. We again suffer a relatively heavy loss, because up to the present time our incandescent lamps give us but a small portion of the energy they receive in the form of light. I estimate that out of the 1,000 horse-power that the central station man buys in the form of energy in coal, he may be able to sell two and $\frac{6}{10}$ in the form of light. He has lost in the various steps about 930 horse-power before he has reached the dynamo. In the electrical apparatus down to the lamp he loses. I am glad to know that the steam engineers are attacking this problem of waste energy in the steam plants in a way that promises success.

Mr. Smith: We have come to the conclusion that it would not pay to have storage batteries in a large building for the purpose of getting rid of night running. We have come to the conclusion that it will cost you as much to get your light from your battery, and you will burn the same amount of coal, for the reason that you at once lose twenty per cent. of your energy in the battery. It will be necessary to employ practically the same force to look after the storage batteries as to run the engines, and we have failed to see that there will be any economy in it.

Prof. Forbes: As to the attendance required in the care of storage batteries, that thing has been minimized on the other side. We find that we can instruct a person of ordinary intelligence in the care of the batteries in a few hours, and often this duty will fall to the carpenter, or gardener, or even butler, on some of the large estates. Even in the larger plants, we do not think it necessary to have any one in constant service; but we have instituted a system of daily and weekly inspection of the apparatus to see that everything works efficiently, and to supply defective parts, and on the whole we meet with much success.

Dr. Bell: I think one reason why the storage battery has been such a failure on this side of the Atlantic is because it has been exploited from the time it first made its appearance here for the purpose of street car traction or other purposes to which it is least adapted, on account of the racking of the batteries in going over rough tracks, and also on account of the frightful variations of the load, which destroys the efficiency of the battery and causes "buckling" and rapid deterioration of the plates. It has been tried with pertinacity worthy of a better cause; but the net result has been failure in this respect. It is a fact that we have put the storage battery to the hardest service that could be imagined, and that has caused the storage battery to fall in disrepute here. If it had been started in the places in which it belongs, isolated plants, such as Professor Forbes referred to, it would have gotten far greater headway in this country, and it is possible that some of the experiments in using it for traction would not have been such lamentable failures.

Mr. Hammer: I think another reason is that in England, France and Germany they use accumulators about the size of a trunk. Probably the small depreciation and commercial character of these accumulators is to a considerable extent due to the massiveness and the mechanical strength of the plates, and the cases in which the accumulator plates are placed.

Professor Forbes: It is perfectly true that in many of the European central stations each accumulator cell is about the size of the bath they gave me in my hotel. I do not, however, think it is true that the size of the cells enhances sensibly their efficiency or the number of plates that they contain. The smaller cells, as long as they are large enough to be made in a solid, mechanical manner, last just as well, and their efficiency is relatively just as good as the large ones.

The convention then adjourned until two o'clock, P. M.

Afternoon Session, Wednesday, March 1, 1893.

Mr. Charles S. Bradley, of Rochester, N. Y., read to the Convention his paper upon the subject of "Long Distance Transmission of Power."

The President: We have three papers on this particular subject: One by Mr. Bradley, one by Dr. Louis Bell, and one by L. B. Stillwell. The subject is treated by the three gentlemen from three different standpoints. The subject will most profitably be discussed after listening to all of them. The next paper on the programme is that by Dr. Louis Bell, which is in order.

The paper entitled, "Power Transmission for Central Stations," by Dr. Louis Bell, was read by Dr. Bell.

Mr. L. B. Stillwell, of Pittsburgh, then read his paper, "Under What Conditions is the Use of Water Power Economical?"

President Ayer: Gentlemen, you have listened to a series of papers pertinent to a topic that is fraught with interest to almost every central station man. The rapid development of our business brings forcibly to our minds the necessity of transmitting large amounts of power over long distances in large units, or, on the other hand, of maintaining central stations and smaller units. As our work in large cities accumulates, the proposition is presented to us that in the near future we shall have to add enormously to our station or generating capacity for the manifold uses of electricity.

To-day we are placed in a peculiar position. Our attention is called to the direct system, moderate sized units, covering a large area, which looks to be a very practicable method for many uses, and also to one very large unit, transmitting power to various centers of distribution and there distributing it, and a further suggestion comes to us, especially where we are located near our coal fields, of generating power at the mine and transmitting it to the various points of distribution; so that it may be wise to consider the advisability of one or the other of the multiphase systems that are offered. My experience is that the more we look into it the less we seem to know. The light that we are likely to get from the discussion of these papers certainly is something that we are all seeking. This is a very complex problem. I trust that you will all take hold of it with interest and draw out of these gentlemen as much as is possible in addition to and in explanation of their papers, remarks which will give us a clearer insight as to the best methods of proceeding in the future. Mr. Hammer, I would like to call on you to open the discussion.

Mr. Hammer: I have a few remarks to make on this subject, which is a pretty large one. Mr. Bell states that it is not practicable to use multiphase machines over 1,200 volts. I think there are machines, not very far from this city, running direct currents of 3,000 and more volts. Moreover, the other night, Prof. Crocker made the statement that he had been running for some time direct current machines of 5,000 or 6,000 volts without any difficulty whatever. Mr. Bell has stated, in speaking of the three-phase system, that the current at one time was passing through one wire and returning through the other two. I think it is generally expressed the other way—that the one wire is the common return of the other two. I do not think he placed enough importance upon the application of the transformer in this country. I think it would be very interesting to all the station men here if Mr. Bradley, Dr. Bell, and Mr. Stillwell and others would get up and state just why it is that the alternating motors of large capacity are not in use. I think an explicit statement of those gentlemen of exactly why that is not done would be interesting. I know they are used for fans, and everybody has an alternating motor that will be supplied in the spring, or something of that kind. I think there is unquestionably an enormous field open for motors of that character, and if any one has such a motor which is practical, there should be no hesitancy in bringing it forward. I would like to hear given a concise statement of just why these motors of larger power are not in use.

I would like to state that Mr. Bradley's paper interested me very much indeed. I think there are some excellent features, and, in fact, a lot of meat in that paper. I think, too, that Mr. Stillwell's paper has a lot of good suggestions in it, and it is a paper which I would very much like to study. He stated in it that the Electric Light Association ought to take steps to collect data upon the subject he discussed, and my impression is that there is a Committee on Data for that very purpose. That committee should take it in hand. I think the idea an excellent one.

Dr. Bell: We know we can make an arc machine to work on high voltage. I practically stated in the paper that high voltage could be used requiring the employment of 1,200 volts or thereabouts, if the machine is designed to carry large currents. Experience up to date has shown that they will not work satisfactorily for any length of time. Although very estimable gentlemen may think that they can build 5,000 and 6,000 volt machines for large currents, they had better build them for large currents before they brag much about them, for all machines which were built for large currents and high voltage have come to grief. Try to run on 50 or 100 amperes and there is trouble at once and immediately. I do not feel at all certain that we may not be able some day, perhaps in another world, to run direct currents, perhaps 3,000 or 5,000 volts, but all our experience up to date has gone to show that when we have gotten a little above 1,000 volts we are in trouble so far as large powers are concerned, and I am not dealing here with matters of 50 or 60 or 70 horse-power, which can be transmitted by a pair of arc machines. We are dealing with the question of handling large powers over long distances. Now, inasmuch as direct current machines for large powers and high voltages have generally come to grief, I think we shall not be justified in saying that they are practical solutions of the question until some one shall have built a machine which both had a large current and high voltage, and made it run with passable commercial success. The commutators on those machines are large and expensive, and I do not think that any one in this room is desperately in love with the commutator. The direct current at high voltage would be a very desirable thing for some purposes if we could get it, but what I mean to say is this, that we have not got it yet.

As to the point of the tri-phase current, I simply intended to convey the idea that there was a slight saving of copper. Inasmuch as the maximum of the three-phases will not coincide, there is a certain amount of unused copper which becomes available which you get the advantage of.

As to the direct current transformer, I am very far from desiring to belittle it. The transformer which takes a current at 1,000 or 2,000 volts and brings it down to 100 or 200 volts, may have a very direct application after we get the high voltage machine. Transforming from 1,000 down to 100 or 110 volts is pretty small business, compared with transforming from 10,000 to 100 volts. The tri-phase multiple transformer is very much more simple than the machine which takes a high voltage direct current and transforms it to a low voltage direct current. The winding is more simple and the machine itself is more efficient.

As to why alternating current motors in large sizes have not been used up to the present time, I think the principal reason is that there has been no very large call for long transmissions until quite recently. Apparatus does not spring up like crocuses in the spring; it comes after a demand for it has arisen; it is dragged out of the inventor's brain when commerce demands. And the reason why we have not had more of this long distance business, is because we have not had any very large call for it. People go conservatively, as people always go. It is perfectly practicable to run large synchronous motors; a matter about which there is no difficulty, and when occasion has arisen it has been done. A paper read not long ago before the American Institute of Electrical Engineers, I believe by my friend Mr. Scott (about which Mr. Stillwell knows much more than I do) covered that very ground of synchronous transmission. So my answer to that will be that as far as the demand has arisen for long transmission employing alternating currents they have been put in, and as that demand occurs they will continue to be put in.

Mr. Stillwell: As to Mr. Hammer's question as to why these motors are not used extensively at the present time, I think that Dr. Bell's answer is very true as far as it goes. The development of new apparatus generally awaits the demand for it. The last ten years have been filled, as far as the manufacturing companies are concerned, with a vast amount of work relating to lighting plants, and in the last three or four years all of the shops have been about as full as they well could be with railway work. At the same time the demand for this long range transmission has existed. The development in this country of the multi-phase systems was taken up, as you know, by Mr. Tesla, or, rather, it was taken up on the other side of the water, and he brought it to this country about 1888, or I do not know whether it was earlier in 1887, and he spent with others a great deal of time in working up the applications of this multi-phase system which opened the door to a type of alternating current motor which would start from rest and work with efficiency. He spent a great deal of time with a number of engineers in working up the very many details which must be worked up before such a system could be put upon the market. The problem of long distance transmission, when we consider it in connection with distribution from central stations, is far more complicated than any problem that has presented itself in the field of lighting or in the field of railway work. There are so many kinds of service which must be considered; it is an extremely broad engineering proposition, and it does not seem to me to be surprising that there has been a slow but, I think, sure evolution of the multi-phase system as it now stands. I will say this, that within the last year there has been a great deal more activity than existed in the previous year or two. The last or at least one of the recent additions to the system, although the thing had been worked out before a long time ago, is the rotary transformer. The application of that, as Mr. Hammer says, is certainly of the greatest value.

There is one point of a great deal of practical interest in regard to the difference between two-phase and three-phase machinery. As you know, Mr. Nikola Tesla is the inventor of the multiphase systems, and after the study of that subject he very early invented the simplest and the most obvious arrangement, viz: the two-phase. Dr. Bell has stated his belief that the triphase has some advantage over the two-phase. There is one advantage of commercial importance, and that must be carefully considered, and that is the slight economy in the investment of copper. The triphase effects a reduction of about 14 per cent. in the amount of copper for the transmission circuits that would be needed by a two phase system. Now, that does not mean that we must increase our potential by any such amount as 14 per cent. in order to come back to even terms on the copper proposition. It is sufficient to go up about seven or eight per cent.; seven per cent. would cover it, unless I am mistaken. Seven per cent. increase of potential would bring the two-phase on all-fours with the three-phase on this point. And, now, as to the points on which the two-phase is distinctly and positively superior to the three-phase or any multiple system. The two phase requires just two transformers at every point where the three-phase requires three. I think that, to a practical man, is sufficient to overrule all of the arguments in favor of the three-phase that have been advanced, assuming all of them to be correct. For a general transmission and distribution project where we must supply power for lighting, and street railway and general purposes, we must abandon the single-phase; we must produce a difference of phase in some way, and having done that, we think it wise—at least it seems to me very desirable—to stop at the simplest form of the multiphase, that is, the two-phase apparatus.

Mr. Adams: It seems to me that the last question that Mr. Hammer asked on the floor was very important. While we may recognize and admit that we have not to-day large alternating systems of transmissions because there has not been much demand for machines of that class, and transmissions of that kind in this country, I do not see that we have an answer to the question "Why we have not to-day, if it is possible to produce such a machine, an alternating current motor, in moderate sizes, which will fill, to use a trite expression, a long felt want?" That is a question, I believe, an answer to which would be very interesting to all present.

Mr. Hammer: I do not consider that Dr. Bell or Mr. Stillwell have answered the question I asked. Take, for instance, in St. Louis, there is a large alternating current station, and I cannot believe that an establishment of that kind would not be very glad to have a large number of 15 or 20 horse power motors to run elevators and things of that kind. If there is nothing in the way of their being supplied, they ought to get them. To dissipate my ignorance on this matter I want to know why they do not get those machines, and I would like to have Mr. Bradley enlighten us.

Mr. Bradley: I tried to build those motors and I have not been able to do it. We suc-

ceeded in building a motor to work on a single-phase alternating circuit which had an efficiency of 52 per cent.—one to two horse power. We have never been able to construct one without a commutator, and wherever a commutator is used the sparking is something dreadful. If it is not bad when the motor is first started, after a few hours it becomes very bad, and we have not been able to design any brush that will obviate the difficulty.

Dr. Bell: I will simply add to Mr. Bradley's statement of the case what I have been able to get hold of regarding the Brown alternating motor which has been exploited in Europe somewhat. The first efforts in the way of getting a motor to run on an ordinary alternating circuit, which would be self-starting, were made by Zipernowski and his associates; that started well, but, as Mr. Bradley stated, had a continuous blaze on the comutator during starting. That killed that motor dead. Now, since that time, Brown, abroad, has been bringing before the public two types of alternating current motor, both of which start fairly well, and are not in any marked degree open to that objection. One of them—one special type of them is, as I remarked before, practically the motor which Prof. Thomson showed at the Paris Exposition, and the other one is practically a Tesla motor, and those two motors have been exploited abroad. They run fairly well. They come up to speed and give, I should think, a very good efficiency. They, however, do not start well.

If Mr. Hammer meant to confine his questions specifically, as I understand now he did, to the alternating current, single-phase motor, the reason why more of them have not been put out is that such motors as a rule do not start very well in small motors, fan size, and that sort of thing. They do start well enough for the purpose, and there are on the market fan motors that do very good service with work on alternating circuits. But the broad distinction between single-phase and multiphase motors is that the single-phase will not as yet start with sufficient facility to give them a good grip; that I hope will be overcome, as I stated in my paper; but at present we have not got it and the commercial demand has not brought it out. I have no grudge against the two-phase motor at all. And as far as the transformers go, it does not make any difference whether it is a multiple of two or multiple of three. In one case we have the same number of wires as in the other; in the three-phase we would only run three wires; in two-phase we run three or four; I think the usual practice tends more to four wires, so that I think the difference is quite largely constructional difference.

Professor Weston: I think that Mr. Bradley hit the nail on the head a moment ago when he frankly admitted that he had tried to build an alternating motor of large power, but had been unable to do so. There can be no question as to the fact that there has been, and still is a large demand for such a system of transmission of power as has been referred to, viz: a simple transmission by means of the ordinary alternating current generator. Therefore, I do not think it is exactly fair to dodge the question. There has been a demand. The demand exists today. The difficulties have been so great that they have not been able to surmount them.

I would like to ask Dr. Bell why he makes the statement that 1,000 volts is the limit of work for the direct current, giving anything up to 100 amperes. I do not think that statement was well founded. I do not know whether Dr. Bell has any particular instance in mind, if so, I do not think the machine could have been designed correctly. I am quite sure of that, for, with correctly designed machines I do not think there is any difficulty in running up to 5,000 volts, and with very large currents—very large currents—several hundred amperes. The question of the advantages of the two processes is still an unsettled one, and will not be settled probably for some years to come; it is a question of the survival of the fittest. But it does seem to me that the direct current system has a great many advantages over the alternating and *vice versa;* just how the matter will terminate we shall have to wait, I think, to find out.

Mr. Bradley: I think this is a question of current; that is, as you increase the current you will have to decrease the voltage. It is not 1,000 volts, nor is it 1,200 volts, nor anything of that kind. With an arc machine having 9 or 10 amperes you can readily reach 6,000 or 7,000 volts; with a machine having 20 amperes you can reach, perhaps, 5,000 or 6,000 volts. I do not mean to say this as a scale; I am merely trying to give an example of what the thing probably is. If it is 50 amperes the voltage has to be reduced. I think that is the explanation.

President: We have among our members here Mr. Nunn, of Colorado, who has been operating a long distance plant with high voltages. I would like to hear from him.

Mr. Nunn: From experience in the back part of the room I am very much afraid I shall not make myself heard. I suppose my testimony in reference to the alternating plant that we have been operating is what is wanted. I can say that from its first installation to the present time it has been under my care, and I consider it a brilliant success, especially when I compare it with direct current systems which are in use around us. Our greatest trouble has been from lightning and from ground—ground very largely. The lightning has caused many defects and made many of the plants failures. It must be understood that we are in an unusual place. Our generating station was something over 10,000 feet high and our first motor installed was something over 12,000 feet high. We have made a run of 45 days without a discharging field of motor or generator. We have installed a 250 horse-power machine, and that is giving satisfaction so far. We do find a little trouble with some minor details, but they are purely a matter of the mechanical construction of the machines and not a part of the electrical connections at all. Ours are of the synchronous type. We have to start our motors with a special starting apparatus, and we once in a while have a little trouble with that; that is; as far as the operation of starting is concerned, very simple. The men who take care of these machines, with two exceptions, are men who never saw an electric apparatus before. I think I have had 16 different men in the last year and a half in attendance upon one motor and without any exception these men have been able to take care of the motor without any trouble. I think this is a compliment, not so much to the sagacity of the men, who were simply western miners, but to the simplicity of the system. It was a matter of considerable delicacy at first, and we were all very much afraid of ourselves. We can usually throw the machine together without a spark—without anything unusual. It makes a beautiful system. We have but two men at the generating station working 12 hour shifts, and they control the speed for our five miles, and control it exactly, whether the motors are loaded fully or running light. The speed varies so little that it is one of the great beauties of our system. It must be understood that we use these motors in driving stamp mills in the reduction of gold ore, and perfect speed is a permanent requirement. I do not think that the time can ever come that in the electrical field can be found a system more beautifully applicable to these cases of long distance transmission in which large units (when I speak of large units I mean over 50 horse-power) are required at a constant and uniform speed on 365 days in the year.

Mr. Henry Hine: My experience is entirely commercial. I am not an electrician nor an inventor. I think that there is a demand for a system, whether single-phase or multiphase, which can be used in cities like St. Louis for supplying power for all sorts of purposes—two horse-power here, two horse-power there, and ten horse-power over there. I think it would be a great advantage if a central station man would be able to run the same generator and same system of circuit in a city like St. Louis. Long distance transmission is one thing; transmission of power for various purposes in a city is another thing. I think that all of the central station men here are looking very anxiously for the time when they can put in generators to run motors, some a quarter of a mile and some two miles from the station, any size, self-starting, and that give no trouble. We are doing somewhat in that line and have been operating motors for some time successfully under our own supervision. I regret very much that Mr. Stanley was unable to come here and take part in this discussion. He has been quite sick and had to go South on account of his health. It seems to me that a distinction should be drawn between long distance transmission and distribution of the power from a single station in a city like St. Louis.

Dr. Kilbourne: I want to say, in regard to the suggestion of Dr. Bell, that I think it a good plan to put your transformers in large banks instead of putting a transformer in every building. We have a bank of transformers, and at night, when our heavy load goes off, we have our night watchman go along and throw off the switches of two transformers, if we have three in the bank, and leave one to carry the load for the balance of the night.

Mr. Stillwell: I have just a word to say. It seems that Dr. Bell and I were under some misapprehension as to the extent of Mr. Hammer's question some time ago. I understood at the time that he referred to large motors, such as would be used in the transmission of power. I will make a distinction, as Mr. Hine pointed out, between transmission of power across country, whether that power is used afterwards in small units or in large blocks, and the distribution of power in large cities from a central station to various small consumers. As to the non-existence of commercial motors to operate on the existing incandescent lighting circuits of alternating systems, I agree with Mr. Bradley that there are very great difficulties there which have entirely prevented, up to this time, the development of a commercially practical motor. It was this difficulty which forced Mr. Tesla to the invention of the two-phase system.

Mr. Hammer: I would like to have Prof. Forbes give us his experience with the two-phase against the three-phase system.

Prof. Forbes: I am very sorry, sir, but I hardly feel able just at this present moment to say much about the relative merits of the two systems. Of course, I shall be having occasions to express my opinions on that subject pretty clearly in the course of the next week or two, and I think it would be hardly right for me to draw comparisons between the two at the present time. I am sorry that I have just missed the reading of this paper, which I am sure has been one of very great interest, and I know that I have lost a great treat by not hearing what Mr. Stillwell has had to say.

I can only say this in response to Mr. Hammer's kind invitation, that both the three-phase and the two-phase system are working very satisfactorily in Europe. I have examined the apparatus and have made tests of the efficiency, and I feel confident that we shall get very good results from either of those two systems. Of course, there are two problems totally distinct, as has been already mentioned—the question of transmission of power, and the question of distribution of power. They are two very different problems and are capable of being treated in totally different ways. Of course, besides these two systems of transmission and distribution, for these are systems which are very applicable for distribution as well as transmission, we have also the single-phase system, which works remarkably well, and of which we have had considerable experience in this country as well as in Europe. The only town in the world that I know at the present moment where alternating currents are used for distributing power is at Heilbron, Germany, but there may be others with which I am not acquainted; that, too, is on a very small scale, indeed the amount of horse-power distributed there is very small. This only shows that the objections which were originally raised against the alternating current for use as motive power have not been completely annihilated up to the present time, but that need not prevent those engineers who have the just consciousness of their views from proceeding to do large work with the alternating current. In this respect I may perhaps be permitted to say a few words about the use of alternating currents with a single-phase. I think anybody who, like Mr. Hammer, for example, has traveled a great deal, and seen work shops of different manufacturers, or, like myself, has devoted a great deal of time to master what has been done in different parts of the world, can hardly go into workshops of any manufacturer of any country where there is originality of design, where the man at the head is a great thinker as well as a good mechanician; you can hardly enter in the shops without seeing some motor work upon an alternating current of a single-phase. I have seen at least a dozen classes of such motors all working fairly well, but there are none of them being put at the present time largely on the market. I am speaking now of motors which will start from rest with a good powerful twist and which will keep up their speed and work economically. Of that type of motors I say I have seen a dozen different kinds in different workshops, and none of them largely used. I regret that I cannot make invidious comparisons between different systems just at the present moment.

President Ayer: This discussion has been exceedingly interesting and I think quite profitable to the membership. We have demonstrated one thing here to the central station men, viz., that our American electricians have very little faith in the promise or in the probability of the development of a practical alternating current motor for the single-phase current. We have had large experience. Mr. Bradley relates some of his in this country and Professor Forbes has given us his observations abroad to the effect that many of the shops have in operation various types of motors of small horse-power—one and two and more, operating fairly well, doing some work and indicative of great promise, and possibly when the heads of the concern are consulted and some attention is called to these motors they do not like to admit that they are a failure. Certainly the evidence is that our various manufacturers and representative men have pretty well concluded that there is little to be gained from them. This is a disappointment to many of us. We have been anxiously awaiting this motor and it is hard to give it up, but with the experience of the past and in view of the opinions we have heard expressed to-day I do not think that any of us will lay our plans for utilizing motors of this character in the near future. The points brought out are the points that are of value to us central station managers. These are the net results that we were after. As I said previously to opening this discussion, the rapid development of the business makes a demand on us for judging what methods must be adopted to provide for the future, and the question is forced upon us for immediate action. We are either turned back to our direct current motors for power, where it is to be utilized in varying units, such as are demanded of us for commercial wants to-day, or else we have to look forward to the development and introduction in the near future of the multiphase motor. We all hope that that time will be hastened so that we may be able finally to decide the problem, because long distance transmission of power goes, and must go, hand-in-hand with the distribution of power.

Professor Forbes: I do not wish a misapprehension to go abroad as to my meaning in what I said about these alternating motors on a single-phase. I am referring, when I speak hopefully of what I have seen, to a transmission of power—essentially of power, in which we are at liberty to reduce the frequency of alternations very considerably.

President Ayer: In speaking of the application or the probability of the early development of a motor for use on our present lines, I referred to the apparatus we have in service, the high frequency apparatus which is utilized in this country, 16,000 alternations per minute, and I am very happy to know that you agree with the opinions expressed here—not that I am happy to know that we cannot get that motor, but that the opinion is unanimous.

The President then laid before the Convention an invitation from the Seigel Gas Fixture Company to visit their establishment, at 219 N. Broadway, and inspect their stock of gas and electric lighting fixtures, and also an invitation from Mr. Henry Sylvester to inspect, at 113 Chestnut street, a model of a special type of underground subway, which, in the opinion of Mr. Sylvester, might be of interest to some of the members, and which he would be happy to exhibit. Also a communication from the Columbian Underground Electric Traction Company, inviting the Convention to inspect a new street railway system, underground conduit. Also an invitation from the St. Louis Car Company to examine a new model president's car by it constructed for the New Orleans street railway system, costing about $9,000, and, at the same time, offering the use of carriages to convey such of the members as signified a desire to examine the car mentioned.

On motion, the Convention then adjourned until 10 A. M., Thursday, March 2, 1893.

Thursday Morning Session.

The Convention was called to order at 10 A. M. by the president, who announced, first, that any of the members of the Association who might desire to visit any of the theatres of the city of St. Louis in the evening would be provided with tickets for that purpose upon application to the secretary; and second, that the first order of business of the day would be the reading of a paper by Mr. W. H. Brown, of New York, entitled "Underground Conduits and Conductors, and the Experiences of the Electric Lighting Companies of New York City."

The President: Gentlemen, you have before you for discussion this paper of Mr. Brown's, which is a very full exposition of the experiences they have had in New York with the underground conduits. The paper, perhaps, considered as a whole, is indicative of the solution of the question or the scheme of operating high pressure currents underground. I would like the discussion on this matter to be as full as possible, but at the same time I desire to remind you that our time will be very limited to-day for the amount of business we have yet to transact.

Mr. De Camp: The paper would, I take it, be more valuable if it were supplemented with a correspondingly detailed statement of the effect of all this on the companies who have been at times obliged to abide by the condition of things brought about by the underground work in New York.

Mr. Francisco: There is no question in regard to the feasibility of placing these wires underground. That has been fully demonstrated. It is simply a question of commercial success. But at the present time it is almost impossible for a company in a place of 300,000 or 350,000 to operate an underground circuit and pay expenses. As a general thing the cost of constructing the conduit would average about $4,500 per mile.

A Member: How many ducts?

Mr. Francisco: One duct only.

Mr. Moore: I would say, having been through the underground law in New York, that I would like to make a little statement of the state of affairs there. The New York situation was brought about mainly, I think, through the stupidity of the companies themselves.

The paper was further discussed at con-

siderable length by Messrs. De Camp, Francisco and Moore.

A Member: Will you please inform me what the name of the topic was of the paper that was read?

The President: It was Underground Conduits. The price of light has some relation to it, although Mr. De Camp has digressed a little.

Mr De Camp: I do not want to digress, but it is incidental to that business.

Mr. Smith: I do not know how other members of the Convention feel, but I have attended some seven or eight conventions right straight along in which this matter has been thrashed out until all the grain was out of it and nothing left but the straw. You can read over the last five printed reports and find that all this has been gone over time and again. You can read them at home and save a great deal of time here. We do not want to go underground if we can help it, and the best way to stave it off is to do good overhead work. But leaving all that aside, I say that the thing has been gone over thoroughly, and I move you, sir, that the discussion close.

Mr. Moore: Now the subway company in New York——

The President: You are out of order. You may ask permission to continue the discussion.

Mr. Moore: I ask leave of the Convention to continue, if you please.

The President put to the Convention the motion of Mr. Smith, to close the discussion on Underground Conduits, and it having been duly seconded, the same was by vote of the members adopted.

The President: I think this discussion is of value to the Association, but to-day we are not at liberty to devote as much time to it as we would like. The next paper on the program is "The Incandescent Lamp from a Commercial Standpoint," by Calvert Townley.

Mr. Townley: Before beginning to read the subject matter of this paper, I want to ask your indulgence to one thing. In listening to papers at gatherings similar to this one, I myself have found it impossible, wherever there was any considerable amount of mathematical formula presented in the paper, to follow the formula while the paper was being read. In preparing this paper which I am about to read to you I obtained some results which appeared to me rather remarkable, and which I do not feel justified in presenting to the Association without giving a certain amount of mathematics to show that they are correct. It has, therefore, been necessary to insert in the paper a number of mathematical formulæ which are more or less of a complicated nature, and in order to make the intelligence of the paper continuous I shall have to read them, but as the paper is printed those who care to do so can consider such formulæ at their leisure afterwards.

The paper on "The Incandescent Lamp from a Commercial Standpoint," was at this time read by its author, Mr. Calvert Townley.

The President: Gentlemen, you have listened to a paper full of interest which I know will provoke considerable discussion, and which is deserving of it, but as it is now almost 1 o'clock a recess is declared until 2 o'clock.

Thursday Afternoon's Session.

Vice-President Armstrong called the meeting to order. The first business was the reading of the paper of Mr. H. C. Meyers on "The Vulcanizing Process for the Preservation and Strengthening of Poles, Cross Arms, Ties, etc."

The paper of Mr. E. A. Armstrong on the "Morals of Corporations," was then read.

THE INCANDESCENT LAMP QUESTION.

The discussion on the paper of Mr. Calvert Townley on "The Incandescent Lamp from a Commercial Standpoint," which was read at the morning session, and discussion on which was postponed until the afternoon session, was then taken up.

Mr. Burleigh: If Mr. Townley or any other gentleman could tell me whether I should be justified in entering into a long time contract for lamps I would be obliged. Mr. Townley refers in his paper to a certain lamp. I would like to ask him if we may expect such a lamp soon, and if it will be generally supplied to those wanting to use it, or if there will be such contracts as are imposed by the other people who manufacture lamps?

Mr. Townley: I suppose the gentleman refers to the stopper lamp. If so, I can say that they are being made and supplied every day.

Mr. T. C. Smith: I have been identified with the Association for a long while, and I think there are members here who know that I have been one of those who has always declared for the central station man as against every other element in the Association. I was one of the first to urge that supply houses should only be made associate members; but I was also one of those who always strenuously argued that their representatives should have the right of the floor in the discussion, and every other privilege, except voting on the official action of the Association. I did this because at the time there were a good many papers, such as Mr. Townley's, of the utmost value to the central station man. It has been urged against such papers that they are to a very large extent means of advertising. We are willing to let them go at that. They create discussion on subjects of great importance to us all.

If, as it would appear at present, there are only two companies that are going to supply lamps to central station men, we are in very poor shape. I have no ax to grind in this matter, our station being in the fortunate position of having been in business prior to July 14, 1891. The General Electric Company must supply us lamps. They have been very nice about it, with this unfortunate distinction: That because we are in a town in which there is a local Edison Company, we are compelled to buy Edison lamps. I do not want to tread on anybody's toes. I am only giving my own experience, and that is, that the Edison lamp for a central station is the poorest lamp on the market to-day. (Applause). We have gone to the General Electric Company and said, gentlemen, we do not use many lamps; we are in the fortunate position of not supplying many renewals to our customers; we have discouraged that, and want to get in the position of the gas companies and supply current through meter. We do, however, supply renewals to a few customers, and we do not care particularly about the price of the lamp. You tell us the Edison lamp is 35 cents. If you will furnish us Thomson-Houston lamps at 45 cents we would rather have them; or if you will furnish us Sawyer-Man, Perkins or Beacon lamps at 50 cents, we would rather have them. They answer, you cannot have these. The Edison Company has the right to sell lamps in this town, and you have got to take that lamp. That is the condition of affairs, but it does not affect us very much; but more than half the central stations have to supply their customers with lamps. They are compelled to take a lamp they do not want. The price has not been raised to any excessive point, however.

I think this Association ought certainly to take some steps, either as a body, or bring its members to some concert of action, to break up this state of affairs. The result of competition in any line of trade is improvement. I do not think I can take any better example than the transformer, leaving out of account the rights of the case—who was the inventor, or who had the best claim—I think no one will deny that the converters at present are not only cheaper, but 50 per cent. better, than the converters we used four or five years ago. This has come from the fact that one company would make an improvement and another company would try to beat them.

The method of dealing with the question before us is a difficult one to outline. I would say, however, that in any discussion that takes place, I hope it will be moderate in tone. There is absolutely nothing to be gained by abusing the fellows on top. They are there, the law has given them the right, no matter what are the equities of the case. What the judges thought of the equities of the case their decision shows; but, unfortunately, the parties in question have the legal right to do this thing. The statement has been made that the company having absolute control will not raise prices, and will not make any arbitrary distinctions. They do make these distinctions, in the fact that they compel you to take a particular form of lamp. The idea that any individual or corporation with absolute power in its hands will use that power is too ridiculous to give consideration for a moment. You will remember that the statement was made in court by the counsel that there was no intention to shut these factories up; that they only wanted their rights to get royalties, etc. I made the inquiry of an authorized official of the General Electric Company whether other lamp manufacturers would be licensed. He told me in so many words: We propose to have this business, and we are going to get it, and you fellows will have to pay the price. Immediately after that came out the question of the Goebel lamp. The change in policy was apparent at once. The minute they get hold of that, they will be there again as strong as ever. I do not want to go into the equities of the case, or go over the history of it. I want to get right down to the meat of the question, which is, How are the central station men going to fight this? I do not think there is a central station man who wants to swindle the General Electric Company or the Edison Company out of anything that the law gives them. They have spent a great deal of money to get this monopoly, and there is no reason why they should not be sustained in it; but I do not think that they should tie us down to using something we do not want. It seems to me that the whole equity of the case would be met if the General Electric Company did as they very plainly hinted they meant to do, and as they wished the impression to go abroad, and that is, that they would license the various lamp manufacturing companies, and charge a royalty. If they do that, I will have no objection. The Edison lamp is made at 40 cents, we will say; the Thomson-Houston at 50 cents. I am perfectly willing to pay ten cents a lamp more for a lamp of any of about ten different makes. It seems to me, if we could bring that state of things about, we would all be satisfied. Let them decide what is a fair royalty to charge. Let them give us a chance to get what we want. Give the lamp manufacturers a chance; the moment the price is at a level, that moment they will have to get the trade by improving their product instead of lowering the price. We want the best lamp, and the best lamp will, of course, in the end be the cheapest.

I do not know that I can say very much as to the policy to be pursued on this question. I know what mine shall be; that I will never buy one cent's worth of material from the General Electric Company until they do that thing. (Applause.) I will never buy one cent's worth of supplies from that company that I can possibly buy from an independent concern; and I shall do all in my power to advance the sale of any lamp which is put on the market which can be manufactured without coming under the law of infringement.

President Ayer: This topic is very interesting and properly should be discussed, but the hour is getting late, and we have considerable business to transact. I do not wish to convey the idea that I want to limit or restrict discussion. I desire, however, that gentlemen will speak briefly and to the point.

In relation to this matter I will state that we have a standing committee on relation of manufacturing to central station companies. That committee and our executive committee, I can assure the Convention, will take such steps as are necessary to bring about the results desired by the Association. These gentlemen will look after the matter, and this thing will naturally be followed up. These committees are composed of central station men only, and they are the men best calculated to carry out the objects of their appointment.

Mr. Howells, of Newark: I was not surprised at all to hear the applause that greeted the statement concerning the Edison lamp. I do not wonder at all at some of the experiences with the Edison lamp, especially on stations where the regulation is anywhere from three to 18 volts more than the normal pressure at which the lamp should be operated. I have made a specialty for the last few years of meeting complaints against the life and performances of Edison lamps. I could bring here a vast amount of data to show the reasons why people had had poor results with lamps, why lamps had performed badly on their circuits; but to get right down to the pith of the matter, a lamp should be operated at the voltage and candle-power marked on the lamp. A 16 candle-power lamp should be operated at 16 candle-power; not 24. A lamp intended for 110 or 114 volts should be operated there. A lamp of $3\frac{1}{10}$ watts should be operated more closely than a lamp of $4\frac{5}{10}$ watts, for obvious reasons. It is a well established law, and one I have found to be familiar to many, that there is a great decrease of life with increase of voltage; and that law is this: Three per cent. increase of pressure halves the life of lamps. That is good for all lamps. Three per cent. on a 50 volt lamp means $1\frac{1}{2}$ volts excess. That $1\frac{1}{2}$ volts excess will halve the life of the lamp. If it be a $3\frac{1}{10}$ watt lamp, and the average life of the lamp under proper conditions be 1,000 hours, that three volt excess will halve the life, or bring it down to 500 hours average life. If you are using a $3\frac{1}{10}$ watt lamp, whose average life may be about 1,800 or 2,000 hours at normal candle-power, that three volts excess pressure will reduce the lamp 1,000 hours. In the case of a four watt lamp, the average life of an Edison lamp will be about 3,000 or more hours at normal candle-power. You may abuse that lamp very much. Your three volts excess pressure will halve the life. Increasing the pressure another three volts, or another three per cent., will bring it down again to half of that, or one-quarter the life—750 hours. That is the reason why the Beacon, Sunbeam, Perkins, and some other lamps, are better than the Edison lamp. They are a four watt or $3\frac{5}{10}$ watt lamp, and they will stand all kinds of abuse and give you a very fair commercial life. In buying lamps you should buy lamps to suit your conditions of pressure. If you can maintain on your circuits a constant pressure with a variation of only one and one-half or two per cent. above or below normal, which is very good, you can operate a $3\frac{1}{10}$ watt lamp with very excellent life about 800 hours. If you cannot maintain your regulation, or do not care to maintain your regulation, you will buy a lamp of lower economy, $3\frac{5}{10}$ watts. If you have commercial reasons, or reasons based on competition, and wish to run your lamps high—if you wish to buy a lamp of 16 candle-power and run it at 24—if your reasons are good for doing so, and you are satisfied with the ledger balance, buy a four watt lamp and run it there; but remember that the life of the lamp is always halved by three volts excess of pressure, and another three volts will bring it to one-quarter of what it would be if operated at the candle-power for which it was intended. I have for the past year or 18 months investigated a very limited number of complaints from Edison central station men, and in not one case have I found a fault to exist with the Edison lamps. In every case I have found the pressure too high. In every case where short life of lamps was proven, the pressure has made the life of the lamp short. In no case have I found a shipment of poor lamps from our factory in 18 months. The Edison lamp is not a poor lamp, but it is not as tough at $3\frac{1}{10}$ watts as it is at $3\frac{5}{10}$ or four watts. You pay your money and you take your choice.

Dr. Louis Bell: I am very loath to enter into this discussion, and it is with great hesitation that I take any hand in it whatever. Although I happen to be with a particular company about which some remarks have been made, I first of all want to be of service to the National Electric Light Association. I do not believe this Association should be made a cat's paw to pull commercial chestnuts out of the fire by anybody. It is not the purpose for which it was founded, and I consider it not only bad form, but discourtesy to the Association, to bring commercial matters into dispute before it, unless at its specific request. I believe it is the intention of the company in question to do, in so far as it is in the power of any corporation, justice to all parties concerned, and to protect central station men who have entered into contracts with either component part of it. There are a number of manufacturers interested in this question, and each thinks the other has transcended his rights, and the question is naturally a hard one to settle, and somebody's feelings are going to be hurt. The only thing to be done is to go over the matter carefully and endeavor to do justice, as nearly as possible, to all parties concerned. I think there are many men in this Association who appreciate the exact condition of things, and to them I think the matter had better be left.

Dr. Bell then criticised some one for permitting his name to be used in an interview which appeared as a paid advertisement of the Westinghouse lamp. T. Carpenter Smith asked if he (Smith) was meant, and to the reply in the affirmative stated that he had not permitted any such use of his name. Dr. Bell afterwards withdrew his remark, and what looked for a moment like a probable personal altercation was amicably adjusted.

Mr. T. C. Smith: I think Dr. Bell has misunderstood the object of this Association when he says it was not organized for commercial purposes among the members of the central stations. Such an utter and absolute going back on all that we have done at the different conventions, at each of which I have been present, I have never heard before.

President Ayer: I think this matter can be left in the hands of the committee appointed for the purpose of considering such a question, and who will take into consideration the grievances, the wants, or desires of the central station interest. I shall be pleased so have some member move that the discussion be closed and the matter referred to that committee.

Mr. De Camp: This is a subject of very great importance to central station men. There is one thing, however, that I think can be relied upon; that we central station men wish the manufacturers to understand, whether it be one company or another, that we are more disposed to criticise the quality of an article than the price; and that if they will make an article worth the money the central station men are perfectly willing to pay for it. (Applause.)

I do not know of any better way of getting into communication with the manufacturing companies on this subject than to refer this question to our committee; and I, therefore, move that the matter be referred to the Committee on Relation of Manufacturing to Central Station Companies.

The motion was put and carried.

A rather general discussion was participated in on the relations of the supply companies to central station men, which was incidentally introduced. Prof. Edward Weston gave a description of the successive stages through which the incandescent lamp has passed, as regards the production of the carbon and guarding against the rapid destruction of the lamp.

The general discussion concerning the supply companies was participated in by Dr. Bell, A. J. De Camp, T. C. Smith, J. J. Burleigh and W. S. Howells.

The question was referred to the Committee on Relation between Manufacturing and Central Station Companies.

Mr. Armstrong offered the following resolution:

Resolved, That the sincere thanks of this Association are due and are hereby tendered to the citizens of St. Louis, the Electric Club, the Electrical Exchange, the Bell Telephone Company and the city press, for the very full reports, as well as to many others, for the very elaborate courtesies they have extended to us, which have rendered our stay here so exceedingly pleasant. We have discovered that the kind proffer of His Honor, the Mayor, in his welcoming address, has been liberally realized—St. Louis and all that she has is ours.

The resolution was unanimously adopted.

Mr. Armstrong offered the following resolution:

Resolved, That we extend, as an Association and individually, our thanks to our esteemed President, James I. Ayer, for the ability and courtesy with which he has discharged the responsible official duties of his position. As individuals we want put on record the fact that, from our experience here in St. Louis at this Convention, we have learned that his affability is perfectly generated, is of the highest efficiency, the lines are innumerable and are all overground; the current is sent out without a drop or flash, and on these lines there is no switchboard, throw-out, cut-off or arrester; and against its power no amount of trouble has been able to act as an insulator.

The resolution was unanimously adopted.

President Ayer responded to the resolution, and expressed himself as pleased to know that the delegates had been so well provided for; and that he, in turn, was indebted to the citizens of St. Louis for the earnest efforts they had put forth on this occasion.

He thanked the gentlemen for the attention they had given to the meetings of the Association.

At this point the regular sessions closed, and the meeting went into executive session.

An interesting feature at this time was the passage through Tenth street of the vehicles used in the service of the Municipal Electric Light and Power Company of Missouri, of which Mr. Ayer is general manager. The procession consisted of the superintendent's light wagon, pole wagon, dynamo wagons for the handling of heavy machinery, linemen's wagons, trimmers' carts, inspectors' carts, line repairers' carts, metermen's carts, and one or two other kinds of carts, the whole aggregating about 80. The company serves a territory of upwards of 60 square miles in St. Louis and East St. Louis, and finds these vehicles necessary in the conduct of its business.

EXECUTIVE SESSION.

In the executive session the secretary's report was read, which showed the Association to be in a most healthy financial condition.

There were 31 new active members gained during the year; and the total membership of all classes is now 250.

Nikola Tesla and James I. Ayer were elected as honorary members of the Association.

A hearty invitation was given to the Association by Dr. E. C. Kilbourne, of Seattle, Wash., for the Association to meet there next year. The invitation was most cordial, and went to the extent to state that the expenses of every one in attendance at the meeting would be paid by the citizens of Seattle.

The following were elected the officers of the Association for the ensuing year:

President, E. A. Armstrong, Camden, N. J.; first vice-president, M. J. Francisco, Rutland, Vt.; second vice-president, C. H. Wilmerding, Chicago, Ill.; secretary, George F. Porter, New York.

New members of the Executive Committee: J. A. Seely, New York; E. F. Peck, Brooklyn; A. J. De Camp, Philadelphia; W. A Morrison, Woodstock, Conn.; H. J. Smith, New York; C. H. Blaxter, Pittsburgh.

The place for holding the next meeting was referred to the Executive Committee.

The Convention then adjourned, the date and location of next meeting being left to the Executive Committee.

The REVIEW publishes in this issue a full report of the proceedings of the Electric Light Convention, and all the papers read, with the exception of two—those by Dr. Louis Bell and Prof. George Forbes. These will appear in full in our next issue, accompanied by additional convention matter.

General Notes of the Convention.

Col. J. W. Marsh and Mr. Fred. Degenhardt represented the Standard Underground Cable Company.

Mr. E. B. McClees, of the Kerite Company, was present, and was welcomed by a host of acquaintances.

Mr. Issertel, of the A. B. C. Company, New York, presented the ladies attending the Convention with tasty bouquets.

The hall where the meetings were held had been handsomely decorated with colored lamps and flags by the Electrical Exchange.

Col. E. L. Babcock, of the Falls Rivet and Machine Company, had the pleasure of securing four large contracts while in St. Louis.

One of Mr. C. O. Baker's most energetic assistants was young Mr. Scribner, of Chicago, who organized a party of visitors from his city and brought them to St. Louis in fine style.

Passenger Agent Haines, of the Pennsylvania Railroad, accompanied the party from New York. Mr. Haines is now looked upon as a permanent feature of electric light conventions.

The widely known Ward arc lamps were exhibited in the corridor of the Southern Hotel, the company being represented by the popular general manager, Mr. R. B. Corey, of New York.

Assistant Secretary Le Vake, of the Brush Electric Company, Cleveland, met several of his former New York friends. W. B. Cleveland, the well known electric switch inventor, was another visitor from Cleveland, O.

George Cutter, of Chicago, had a large board in the corridor on which appeared neatly arranged samples of the many specialties which he manufactures and which are meeting with so large a sale in all parts of the country.

The absence of Fred. W. Royce was greatly regretted. Every one was, of course, glad to see his partner, Mr. Marean, but no one can fill the vacuum caused by the absence in body of the senator from Washington. No doubt he was present in spirit.

Mr. C. E. Carpenter, of Bridgeport, Conn., represented the Carpenter Enameled Rheostat Company, and exhibited several of his rheostats. His company is one of the busiest in the field, and Mr. Carpenter was much sought after by the practical electric light men.

Mr. C. A. Bragg, the Philadelphia Quaker, had the credit of carrying off the highest honors as story-teller. Those who have never heard and seen his kettle drum story have missed one of the prettiest bits of pantomime ever met with outside professional circles.

The Boston Arc Lamp Company was represented at the Convention by M. M. Merritt of the company. This concern manufactures special lamps for arc circuits. This concern is formed of young men, who were all formerly connected with the Thomson-Houston Company.

The Electric Engineering & Supply Company, of Syracuse, N. Y., occupied a parlor on the parlor floor, and presented a large and interesting array of their manufactures. This is one of the most enterprising and progressive manufacturing companies, and is crowded with work in all departments.

The Bryant Electric Company, of Bridgeport, had set up in the corridor a very handsome exhibition switch board containing samples of the various switches manufactured by this company. Mr. W. C. Bryant was present in person, and was many times congratulated over the attractive exhibition.

The Cutter Electrical Company, of Philadelphia, had a neat parlor exhibit, and was represented by Mr. Henry B. Cutter. The excellent switches manufactured by this company were shown in operation, the C. S. flush commutation switch receiving much attention on the part of all the visitors.

Mr. Geo. T. Manson was present as the New York representative of Okonite wire and Manson tape, and President McKinlock and Chas. E. Brown, of the Central Electric Company, Chicago, also lent the manly beauty of their presence to the scene, and advanced the cause of said wire and tape and other things.

The Weston Electrical Instrument Company, of Newark, N. J., had a beautiful and interesting exhibit in a prominent parlor. Prof. Edward Weston was present in person, and renewed pleasant acquaintances with a host of friends. Mr. R. O. Heinrich and Mr. C. D. Shain were also present from the same company.

The Stanley Electric Manufacturing Company, of Pittsfield, Mass,, was represented by its president, Mr. Charles Atwater, General Manager Henry Hine and Mr. Albert Taylor. The winning ways of the gentlemen won them many new friends, and the reception they tendered to President Ayer, Nikola Tesla and others Wednesday evening, at the Southern, was a very enjoyable affair.

Although it was not expected that there would be any exhibits at this Convention, a number of enterprising manufacturers brought samples and goods, and exhibited them in their parlors and rooms at the hotel. This added to the interest of the occasion, of course, and as nearly all the exhibits were of latest design, the electric light men were constant visitors and inquirers at all of them.

One of the most pretentious and interesting exhibits of the Convention was that of the General Incandescent Arc Lamp Company, of New York, represented by Mr. A. Noll. A large rack was fitted up in the corridor, and numerous beautiful arc lamps, all in different styles, were hung on it. This proved a point of great interest to all, and the appearance of the lamps attracted a great deal of favorable comment.

Manager Hall, of the "C. & C." motor, found time to leave town and appear at the Convention. Mr. Hall is a very busy man, and so his many friends were more than glad to see him at such a time. It was unnecessary for him to make the trip in order that delegates should know about the "C. & C." motor, as it is as widely known, with just as many friends to sing its praises, as any motor on the market.

Col. E. L. Babcock and his son, Mr. C. A. Babcock, of the Falls Rivet and Machine Company, Cuyahoga Falls, had pleasant headquarters, and exhibited a beautiful model of their clutch pulleys, as well as a number of drawings and photographs of several large installations they had recently made. Among these were the drawings for the new power plant for Mr. Fred. Cheney, of Elmira, N. Y.

The Fort Wayne Electric Company kept open house in the large parlor, and was represented by C. S. Knight, Prof. J. J. Wood, W. J. Morrison and E. T. Pardee. The Wood alternating arc lamps and the constant potential arc lamps were exhibited in operation, and attracted a great deal of attention. These parlors constituted most popular headquarters, and were visited by probably every attendant at the Convention.

Mr. C. E. Bibber, the head and front of the Consolidated Electric Manufacturing Company, of Boston, was present, and as active as ever in presenting the excellence of his manufacture. Plan views of his new 60-light dynamo were distributed. In the same parlor with Mr. Bibber, Mr. H. H. Brooks, of the American Circular Loom Company, of Boston, exhibited samples of his canvas jacket wire, also his canvas jacket tubing.

Mr. Chas. E. Newton, of the Jewell Belting Company, won the never-dying praise of the electric light men by presenting to each a leather pocket-book, to be used for carrying bank notes. As a sample of the style of funds it was intended for, a bill of the denomination of $100, was enclosed in each. The bill only lacked the government's official stamp to make it of full face value—a slight oversight scarcely worth mentioning.

The Bryant Electric Company's sample board of the different goods manufactured by them was exhibited in the corridor of the Southern Hotel. This company have made rapid progress in their line this last year by acquiring the Paiste switches, china arc cut-outs, etc., and they have also added many specialties of their own. W. C. Bryant and Thos. G. Grier represented them. Mr. Bryant is a very energetic young man and is making many friends and keeping old ones by his businesslike methods.

A number of small exhibits were to be seen in the corridor, including samples of the "Salamander" wire of the Washburn & Moen Manufacturing Company, Worcester, Mass.; Chapman Valve Manufacturing Company, of Boston and Chicago; the Falconer Manufacturing Company, of Boston, represented by A. G. Sargent, and the Hart & Hegeman Manufacturing Company, of Hartford, Conn. The last named company had a beautiful little board of switches, and their new flush switch attracted general attention.

The Eddy Electric Manufacturing Company, of Windsor, Conn., exhibited their new 15 horse-power, type "H," electric motor in operation in a large room on the office floor of the hotel. The motor has a speed of 600 revolutions, and is one of the most efficient and satisfactory productions yet turned out by this enterprising and progressive company. Mr. A. D. Newton and Mr. M. E. Baird, of Windsor, Conn., and G. A. S. Kohler and F. W. Hohler, of the Chicago office of the company, were in attendance.

The Helios lamp was vigorously represented by the only D. C. Spruance. He was conspicuous on all occasions, and the boys warmly congratulated him on the good prospects of his lamp. Mr. A. J. Martin, a central station man from Philadelphia, has been burning several Helios lamps, and furnished enthusiastic testimonials of their efficiency to the delegates who were interested. The Helios Company have secured several large contracts and it is safe to say that this lamp will cut a considerable figure among the successful lamps of the future.

There is a man who goes to conventions who is unique among delegates, and his name is Hatch, and he always knows it. Now we have told you who he is, it is unnecessary to describe his many characteristics, for every one knows him. We suppose as long as conventions exist, just so long will Mr. Hatch continue to maintain his convention record. He has told you before we have had a chance all about Vulcabeston and his other specialties, and it is unnecessary for us to supplement his statements, except to say that his goods are "All wool and a yard wide."

A NEW DELEGATE.

A marked feature of the late Convention was that in many cases those who attended were principals in the varied lines of business represented there. One of these principals, a gentleman who has not before attended, was welcomed most royally. This new delegate and friend was Mr. George J. Jackson, of the Norwich Insulated Wire Company, of New York, who brought with him an elaborate and special case containing full samples of the various kinds of wire manufactured by his concern. Mr. Jackson has gone into the wire business very deliberately, and since buying out the former Norwich Company, he has given the business his close personal attention. What is bound to happen under these circumstances is true of his concern. By carefully feeling their way, this concern has been able to turn out wire which has attained a high degree of excellency. Some of the tests made have been remarkable. Mr. Jackson has been in the business long enough to talk wire against all comers, and, doubtless, he will be delighted to impart all necessary facts and figures.

THE ELECTRIC SELECTOR AND SIGNAL COMPANY.

One of the most novel and interesting exhibits at the Convention was to be found in parlor 54. In this room was seen a real moving show with the wheels going round all the time. The concerns who contributed to the very complete electrical equipment of this section were the "C. & C." Motor Company; the Electric Selector and Signal Company (late the Electric Secret Service Company); and the Interior Conduit and Insulation Company, all of New York. The generating plant which furnished power for operating the lamps, motors and other apparatus were a "C. & C." motor and dynamo. The motor took current from one of the street circuits and turned the dynamo, a continuous current 115 volt machine. The current thus generated was used for operating the chief attraction of the exhibit, the ingenious selective or individual cut-outs of the Electric Selector and Signal Company. Sufficient of these devices were installed to show very thoroughly the capabilities of the system. On a long shelf were placed the transmitter, assumed to be at the central station, and a number of selectors and automatic switches, each controlling a group of incandescent lamps or a Lundell fan motor. By attaching a combination disk to the transmittter and pressing a key any one of the selectors was operated without in any way interfering with the others. One transmission of the combination threw the switch in one direction and a second threw it in the opposite direction, showing that the loops controlled by the selectors could be cut in and out of circuit from the central station just as surely as if the switch itself were within reach of the station engineer. To show the application of the system to arc light circuits, an arc lamp hung on a pole in the street outside was cut in and out in the same manner, the selector and automatic switch for this class of work being placed in a weatherproof iron case. The operation of this system was watched with keen interest by central station men and others, and no one could look at it without figuring out various applications where it would save work and money to the central station manager. The Electric Selector Company was represented by C. P. MacKie and Herbert Laws Webb, and Messrs. Hall and Little, represented the "C. & C." and Interior Conduit Companies, respectively.

The Beacon Lamp Case.

At Boston, on March 7, the Beacon Vacuum Pump and Electrical Company asked Judge Colt to suspend the preliminary injunction against it for an infringement of the incandescent lamp patent, pending the determination of an appeal which it will take from that decision. The request was refused.

Gifts Worthily Bestowed.

MASTER OF TRANSPORTATION BAKER RECEIVES A PUNCH BOWL AND SECRETARY PORTER IS WATCHED.

There were so many pleasant episodes at the late Convention that one is quite puzzled to remember them all. One of the memorable occasions was the gathering together of the delegates in the main parlors of the Southern, to tender a supper to Mr. C. O. Baker, Jr. All were anxiously waiting for the appearance of Mr. Baker on the scene, as he was the only one to be surprised. He came at last, flushed with victory over the railroad company, which gave the delegates a very favorable opportunity to visit Chicago on their way to New York, little suspecting what was in store for him. Mr. T. Commerford Martin mounted a chair and added fresh laurels to himself as an orator. Mr. Martin said:

"Of old, the god of speed and transportation was Mercury; to-day, for us, he is Platinum. It is this little fact that brings us together here this afternoon, for, as you all know, we are met to offer some little token of recognition and esteem to the Master of Transportation, Mr. C. O. Baker, Jr., through whose care and skill the Electrical Special from New York to St. Louis made so pleasant and successful a trip at the beginning of the week. We little know how much we owe to him for the comfort of so long a journey, and the largeness of the attendance at the meetings. When this latest 'Special' was arranged for, many of us doubted whether it could be carried through; and it was feared that the recent severe 'cold snaps' might not only have frozen some out of the business, but lessened the desire of others to make the trip. Still, thanks to Mr. Baker's energy, when we got together on Sunday, we found as strong a muster as ever—at least a hundred strong. There were 34 supply men, 56 newspaper men, free and easy Masons from Brooklyn, Roycesterers from Washington, and one meek and modest central station man, who was there probably because he has an interest in a supply company. It is needless to say that under such circumstances, and with such company, the trip was a delightful one. All of Mr. Baker's 'personally conducted tours' are, for they do much to develop and cultivate the spirit of good will and fraternity that should prevail in such an industry as ours, where every one's welfare depends on what others do. To illustrate the charming sentiment of amiability fostered by these occasions, I may cite the action of my friend, Mr. John Seely, at the close of the journey. 'Honest John' had been playing poker all the afternoon, and as we reached the Illinois end of the long St. Louis Bridge, found himself some fifteen or twenty dollars to the bad. Rising to his feet, and sweeping up the cards—he had no chips left—he said, with the broad and lofty generosity that always characterizes him: 'Boys, I don't see why we can't compromise this thing!' With equal self-sacrifice, the winners declined any negotiations on that basis.

"But, ladies and gentlemen, Mr. Baker is among us, and I hasten to release him from an embarrassing position. He has brought us in safety from the garbage-haunted shores of the silvery Hudson to the smoke-stained banks of the rolly Muddysippi. We feel we owe him something for this and other kindnesses, and have embodied our ideas in this punch-bowl. To dwell on his virtues would simply be to gild refined platinum and paint red the blushing carnation, and I refrain. Mr. Baker, the bowl is yours."

Mr. Baker, although greatly surprised, very appropriately accepted the gift. He said, among other things, that "inasmuch as he was the recipient of so beautiful a punch-bowl, he would invite all his fellow delegates to come and see him, and show him what to do with it." The party then adjourned to another parlor. This testimonial was the gift of Eastern delegates who went to St. Louis on the Electrical Special. Mr. Fred. Royce and Mr. W. J. Morrison were largely instrumental in bringing about this happy event.

After this pleasant episode, Secretary George F. Porter was presented with a very handsome and valuable gold watch, the presentation speech being made by Judge E. A. Armstrong. Mr. Porter was completely overcome, but managed to express his thanks fittingly.

The Hammond Electric Street Railway, Hammond, Ind., is approaching completion. The steam plant was furnished by the Chicago office of the Ball Engine Company, 506 the Rookery.

Motors for Alternating Currents.

BY F. H. LEONARD, JR.

The alternating system has heretofore been lacking in a very essential feature detracting from the earning capacity of a central station, from which it is operated. We have until now seen in practical operation no motor operated from simple two-phase alternating current which could be termed a commercial success. Many futile attempts have been made to produce such a motor, and the minds of the greatest inventors of this and other countries in the civilized world have been struggling with this knotty problem. Expensive experiments have been made in this country and in Europe on what is now known as the multiphase system, and where cheap power is obtainable, motors operated from such a system will no doubt meet with a limited success; but the low commercial efficiency of this system of power distribution, together with the other objections associated with it, prohibits its use where the cost of fuel or power is a matter of any importance.

The use of three wires, which is necessary with the multiphase system, not to mention the added parts of the generator, complicates the system, which must be balanced up in much the same manner as the Edison or Hopkinson three-wire system, without gaining the advantage in the reduction of copper, but, on the contrary, adds one-third to the cost of conductors, provided the same pressure is maintained.

The converters required to operate motors from a multiphase system must have a capacity enormously in excess of what is actually required in watts to perform the work the motor is calculated for, and when it is desired to operate incandescent lights from the same circuit, a special transformer of complicated form is required, and to operate to best advantage this transformer must have both branches equally loaded.

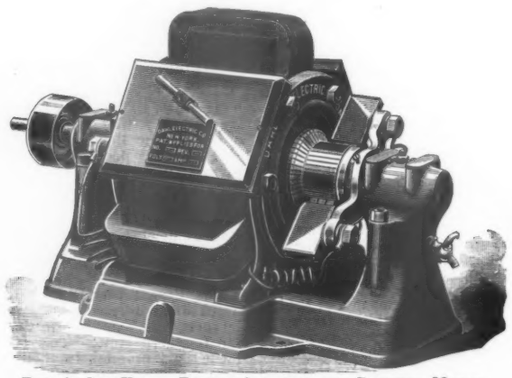
We doubt if such a system can ever be successfully and extensively introduced into this country, where the simple two-phase alternating system has taken such powerful root, and branched so rapidly and extensively. Consider what such a change would involve. The present generators must be abandoned, the present system of wiring must be entirely remodeled, and a third wire added. The present converter must also follow the generator to the scrap heap, and the system of inside wiring must be remodeled to suit the changed conditions.

We might put up with the change in generators alone, for the sake of adding to our income the revenue to be derived from motors, and complaisantly consider the much evener curve in the ampere output of our central station plant, which would then be earning almost as much during the hours of daylight as during the hours of darkness; but shall we do the rest—shall we abandon our present system entirely, and go down into our pockets for the price of an entirely new equipment? No! We trust we shall never be compelled to, for already in our dreams we see the ideal central station, which we have every reason to believe will be realized in the near future.

Let us briefly sketch this ideal. A central station operating night and day with practically the same output in ampere hours from 6 A. M. to 6 P. M. as from 6 P. M. to 6 A. M., equipped with high pressure boiler, furnishing steam to triple expansion upright engines coupled direct to alternating current generators without collector rings, commutators, or brushes or any moving wire, which, owing to the reduction of iron losses are more efficient than those in use to-day, furnishing a simple two-phase current at a primary pressure, perhaps not materially different from the present standards, except for special long distance transmission, when, by changing armature connections the same generator may produce much higher pressure, or the electromotive force increased by step up transformers. The current from these generators transmitted over the same system of distribution as used at present, except where conditions might warrant underground wiring, at the house transformed by a single two-phase converter, improved as to regulation and leakage loss, to a safe pressure for commercial and domestic use furnishing arc lights, incandescent lights and power not only for stationary purposes, but for locomotive purposes in propelling street cars, suburban railways, and even by sections the trunk lines of the country; and not to forget electro deposition by motor generators furnishing direct currents for plating as well as for charging storage batteries.

The key to this happy idealistic situation lies in the production of a practical simple two-phase motor, which can be connected to any of the present alternating systems, whose lines of distribution penetrate the vitals of so many of our largest cities, weaving a network through its many arteries to its outermost extremities.

Mr. Olof Dahl, of the Dahl Electric Company, has produced such a motor, and a number of them are already in daily use. These motors can be made in any size, from one horse-power upwards, are synchronous, hence, *must* run at a uniform speed, provided the generator runs steadily, and are self-excited, starting themselves vigorously with a torque about equal to their normal capacity. They have a commercial efficiency equal, if not superior, to the best direct current motors, the one horse-power size having an efficiency of 75 per cent. and increasing with the size of motor up to over 90 per cent. There is no undue heating in any of the parts, and neither armature nor field coils rise in temperature more than 30 degrees above the surrounding atmosphere under normal load, and there is no heating of the field cores. Should the armature be stalled, and this does not occur till the motor has 50 per cent. overload, the armature is not injured and no serious heating of the coils takes place, the current being choked back by the self-induction.



DAHL'S ONE-HORSE POWER ALTERNATING CURRENT MOTOR.

This motor is designed to operate on the alternating system in use at the present time, without any reduction in the number of alternations which is called for in the use of the multiphase, involving, as it would, more expensive transformers, greater in weight proportional to the reduction of alternations.

We can start at once to increase the earnings of our alternating central stations, without the slightest change in our system of distribution, from the lines already erected and from the same transformers used for lighting at night, motors can be operated in the daytime, and both motors and lights at night, if the capacity of the transformer is sufficient.

Magnetic Pulleys.

M. de Bovet has brought out an ingenious system of magnetic pulleys. In the case of a chain pulley, the ordinary system with recesses wears the chain away rapidly, and in time the pitch of the chain and pulley do not correspond. M. de Bovet uses a pulley with a deep recess containing a coil. This magnetizes the pulley in such a way that the links of the chain complete the magnetic circuit. The pulley thus resembles a plain cylinder with a groove. Alternate links lie flat, completing the circuit, while the others fit loosely into the groove. Such a chain pulley as this runs smoothly and gives no trouble even when worn. It can also be used for driving flat strips of steel, which might be used as loose belts.—*London Industries.*

On Her Dignity.

LARKIN (at telephone)—Hello!

NEW GIRL (at central)—Is that the way to address a lady who is a perfect stranger to you, sir?—*Judge.*

ELECTRIC RAILWAY AND POWER NOTES.

It has been determined to equip the Jacksonville, Fla., street railroad with electric motive power, and it is expected that the work will be begun during the present week.

It is thought that the only reason that Lake Contrary, Mo., is not a popular summer resort is that there are not sufficient transportation facilities between that place and St. Joseph. It is hoped that electricity will fill the bill.

Owing to recent successful tests of storage batteries, it is proposed to run the road from Los Angeles, Cal., to San Bernardino and Riverside by that means, obtaining the power from works at the head waters of the Rialto water supply.

Nevada City, Cal., is to have an electric railroad which will run from that city to Grass Valley and Marysville. The work of constructing the road-bed and laying the rails will commence as soon as the winter storms have subsided.

Kalamazoo, Mich., will have electric cars running by next June. The council will soon grant a franchise, and as the present street car service is losing $1,000 per month, the cars will stop next week and there will be no more street car service till the electric cars are put on.

The General Electric Company, of Chicago, has just completed the survey of the contemplated fast line between Peoria, Ill., and Pekin. The East Tazewell side of the river was surveyed from a point at the intersection of Adams and Bridge streets to the court house in Pekin, and the distance is nine miles.

A prominent resident of Ottawa, Ont., stated this morning that within seven years steam power would supersede the water power of the Chaudiere for electrical purposes. He says that for two days lately the demand upon the water wheels and motors for electrical purposes exceeded 1,000 horse-power pressure.

For several days the representatives of a New York syndicate have been in Columbus, O., negotiating for the purchase of the three street railways and the two electric light plants. The facts in the case are being kept from the public, but it is learned that options on some of the plants have been secured and that the deal will probably be made.

A bill to authorize the experimental use of the trolley as a motor for boats on the Erie canal has been introduced in the Assembly, and since the privilege would involve no expense to the State, and would be in line with Governor Flower's recent suggestions on this subject, it may be assumed that the canal trolley will ere long try conclusions with the "donkey engine."

The extension of the trolley electric railroad from Yonkers to Mount Vernon, a distance of three miles, is nearing completion. Such a road, affording cheap and rapid transit between those two cities, has been long needed. This road will ultimately be extended to Long Island Sound, probably in the vicinity of Glen Island. The fare in the cars to Mount Vernon will be 10 cents.

It is stated that William H. Parker, a large land owner of Bloomington, Ill., has offered the management of the Chicago and St. Louis Electric Railway Company $3,000 in cash to have the line built one mile further east through Austin township in Macon county, in order that it may go through the middle of the Parker farm and give Austin a town. The proposition will doubtless be accepted.

There is an enterprising and progressive man who should be imitated by all worthy and birth-place loving citizens. The Hon. Judge Hoffa, of Lewisburgh, Pa., has noticed the rapid oncoming of the electric railway system, and is so thoroughly convinced that this system will supplant steam roads and enhance the value of property wherever they run, that he offers to donate $1,000 to any electric railway company that will build a line anywhere within a half mile of his residence and estate in Kelley township.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

New Electric Railways.

SANTA CLARA, CAL.—The Santa Clara supervisors have granted three electric railway franchises.

COLUMBUS, OHIO.—The Crosstown Street Railway Company has been incorporated for the purpose of consolidating the Glenwood and Green Lawn and the Leonard Avenue street railway lines. The incorporators are C. H. Allen, W. F. Burdell, W. D. Park, N. A. Sims and F. W. Prentiss.

LANCASTER, PA.—The Lancaster and Downington Street Railway Company, capital, $1,000,000, has been incorporated by Jesse Wingert, Geo. W. Meily, S. A. Hench, of Harrisburg; H. B. Pipar, of Tyrone; and John A. Clark, of Lancaster. H. B. Pipar, is president. The road will be operated by electricity, will be 30 miles long, and will run through Smoketown, Bird-in-Hand, Intercourse and Leacock to New Holland, returning by the same route through Leacock and Spring Garden to Downington.

BELLAIRE, OHIO.—A company of Pittsburgh capitalists, if given a bonus, will consummate an agreement for a franchise and right of way for a street railway in Bellaire, Bridgeport, Martin's Ferry, and five miles on the national pike, in all 14½ miles.

WATERTOWN, N. Y.—It is proposed to establish a city electric light plant, to cost $60,000.

DAYTON, OHIO.—The Dayton, Germantown and Middletown Electric Railway Company; capital, $10,000. Incorporators, Chas. L. Dunham, Albert Boone, F. B. Lilly, J. B. Yates and M. T. McGregor.

BINGHAMTON, N. Y.—The Court Street and East End Railway Company is making arrangements to change the motive power of the road from horses to electricity.

ASHLAND, PA.—The Schuylkill Traction Company may extend its line to Locust Gap and then connect with the Shamokin Electric Railway, and also extend it East and connect with the Schuylkill Electric Railway at Port Carbon.

SCRANTON, PA.—The Scranton and Carbondale Traction Company; capital, $10,000. Incorporators, Alfred A. Chandler, Philadelphia; John W. Towler, Samuel D. Pettit and Henry H. Sivelly, of Scranton.

CONSHOHOCKEN, PA.—The Schuylkill Highlands Railway Company; capital, $10,000. Incorporators, Frederick Phillips, S. T. Kerr, Philadelphia; C. Gage, Boston, and H. C. Landis, of Camden. The line will run through Conshohocken and West Conshohocken.

WELLSVILLE, OHIO.—It is proposed to build an extension of the Liverpool and Wellsville Electric Railway to New Lisbon, a distance of 18 miles, and then extend the Salem line 10 miles to meet the extension.

SIOUX CITY, IA.—The control of two miles of elevated and three miles of surface road, formerly belonging to the Sioux City Rapid Transit Company, has passed into the hands of the Sioux City Street Railway Company, and the steam motors will be replaced by an electric trolley system.

MONTREAL, CAN.—The Montreal Electric Railway Company will erect a motor house capable of furnishing 6,000 horsepower, and expects to lay 60 miles of new track.

ORANGE, N. J.—F. M. Eppley, of the Orange Crosstown Railway, talks of building another electric line from Bloomfield to Paterson.

RICHMOND, VA.—The supervisors of Chesterfield County have decided to give Wm. H. Palmer, W. Pemberton, T. M. R. Talcott and Geo. H. Jenett, the right to build an electric line from Manchester to Petersburg, a distance of 21 miles.

BOWIE, TEX.—At a meeting of the city council, Head & Company were granted a franchise to construct and maintain a street railway.

YOUNGSTOWN, N. Y.—It is now thought that the Lewiston and Youngstown Electric Railroad will be built before fall.

TRENTON, N. J.—Arrangements have been made to extend the Trenton trolley system to Rushings, within a few miles of Bordentown.

STATEN ISLAND, N. Y.—The application of the Belt Line Company for leave to change its motive power to electricity, has been granted by the railroad commissioners.

LONG BRANCH, N. J.—The Long Branch commissioners have granted a franchise to the West End and Long Branch Street Railway Company to lay tracks on Second avenue.

BENNINGTON, VT.—The owners of the electric lights plants at Bennington and Hoosick Falls, N. Y., have in contemplation the building of an electric railway between the two towns.

SCRANTON, PA.—The Jessup Rapid Transit Company; capital, $24,000. Directors, John J. Sweeney, of Winton; D. H. Barry and E. S. Dolph, of Scranton; W. G. R. Robertson, of Dunmore; and J. W. Smith, of Peckville.

MARLBORO', MASS.—Ex-Mayor S. H. Howe has purchased a controlling interest in the Marlboro' Electric Street Railway Company.

PHILADELPHIA, PA.—Stockholders of the new Manayunk and Wissahicken Electric Railroad have authorized the construction of the road without delay. Peter P. Liebert is president; Isaac Wilde, vice-president; and John Flanigan, secretary and treasurer.

PEN ARGYL, PA.—The Pen Argyl, Bangor and Water Gap Electric Railway Company; capital, $300,000. President, A. J. Strop, of Sunbury. The road will run from Wind Gap to Pen Argyl, through Delaware Water Gap to East Stroudsburg.

COLUMBUS, OHIO.—The Columbus Street Railroad Company has asked council for franchises for extensions.

New Manufacturing Companies.

CLEVELAND, OHIO.—Tremain & Crouse will establish, at Fostoria, a plant for the manufacture of electric light carbons. The factory will cost about $50,000, and will start with 100 men.

ELIZABETH, N. J.—The Mica Insulator Company; capital, $100,000. Incorporators, Lewis W. Kingsley and Franklin Brooks, of Elizabeth; Eugene Munsell, of Branchport; Chas. W. Jefferson and Arthur H. Saulsbury, of Schenectady, N. Y.

CHICAGO, ILL.—The Elwell-Parker Electric Construction Company; capital, $500,000. Incorporators, Frederick C. Phillips, Robert L. Tatham and Chas. R. Webster. The company will manufacture electrical and other machinery.

UTILITY.

MRS. MURPHY—An' phy do they put all thim wires an thim poles fur?
MR. MURPHY—Sure if I knew ye were that ignorant I wud never married ye. Yure own common since moight tell yez that they puts the wires an the poles to hould the poles up.—*New York Truth.*

ASHLAND, WIS.—An electric power and storage company has been formed, with a capital of $100,000, by Ashland parties. The company will manufacture electric storage batteries, under the patent secured by Leslie B. Rowley, of Ashland.

CHICAGO, ILL.—The Western Telephone Construction Company; capital, $100,000. Incorporators, James E. Kerlyn, George F. Stitch, John F. Scanlan and Miles Kehoe.

NASHVILLE, TENN.—The City Electric Light and Power Company is an applicant for a franchise.

NORWALK, O.—The Norwalk Electric Company has been incorporated with a capital of $50,000.

BINGHAMTON, N. Y.—The Columbian Manufacturing Company; capital, $20,000. Incorporators, Eli S. Meeker, Lowell Blanding, F. E. Ross and S. H. Sharpsteen. The company will manufacture water and electric motors.

ORANGETOWN, N. Y.—The Fiber Conduit Company; to manufacture and sell pipes, conduits and tubes; capital, $50,000. Directors, Stephen R. Bradley, Jr., John D. Bradley, of New York City, Geo. C. Stephens, of Upper Nyack, and D. A. Van Ingen, of Brooklyn.

Electric Light and Power.

CALDWELL, OHIO.—Bonds to the amount of $25,000 will be issued for electric lights and street improvements.

JERSEY SHORE, PA.—The Jersey Shore Electric Heat, Light and Power Company has been incorporated with a capital of $5,000.

LANSFORD, PA.—The Panther Valley Electric Light, Heat and Power Company; capital, $10,000. Incorporators, W. W. Thomas, G. W. Davis, J. E. Dauer, J. A. Quinn and J. W. Maloy.

WATERTOWN, S. D.—An electric mining plant costing $100,000 will be put in operation next summer in the Congress placers, near Spearfish.

CHICAGO, ILL.—The Adams Electric Manufacturing Company; capital, $500,000. Incorporators, William B. Mather, William L. Sutherland, James S. Wheeler, Jr.

WATERFORD, N. Y.—The Union Electric Light and Power Company, a consolidation of the Union Electric Light and Power Company and the Waterford Electric Light and Power Company; capital, $150,000. Directors, E. S. Kaufman and W. E. Acker, of New York city; Horace C. Train, of Green Island; William M. Lea, of Lansingburgh, and others.

OGDEN, UTAH.—The Salt Lake and Ogden Gas and Electric Light Company contemplates making improvements in the Ogden plant, to cost not less than $100,000.

RIDGEFIELD, CONN.—It is intended to locate an electric light plant in Ridgefield.

NASHVILLE, ILL.—The Nashville Mineral Springs Company has filed a certificate to add to its object the construction and operation of an electric light, power and street railway plant, and increasing its capital from $5,000 to $15,600.

CHICAGO, ILL.—The Electric Purchasing and Investment Association; capital, $10,000. Incorporators, W. D. Gregory, Chas. E. Randall and E. M. Stannard.

New Telephone Companies.

BUFFALO, N. Y.—A new corporation formed recently is the Pulsion Telephone Company, of Western New York. Its papers have been filed, and it will operate in Erie, Niagara, Chautauqua and Cattaraugus counties. The telephone lines are to be private and not connected with any general office. Its principal office is to be in Buffalo, and its capital is $50,000. Harmon W. Ladd, of Boston; George R. Taylor, Edward Smith, John C. Bains and Fred L. Bennett, of Buffalo, are its directors. Mr. Ladd will be the manager. The instrument is not electrical, but works by a system of harmonized vibrations. The purpose of the company is to render telephone service cheaper.

RENVILLE, MINN.—The Renville Consolidated Telephone Company; capital, $15,000. Incorporators, Jesse T. Brooks, M. J. Dowling and Timothy O'Connor.

QUINCY, ILL.—The Citizens' Telephone Company; capital, $100,000. Incorporators, James R. Smith, Wm. S. Warfield, George Wells and Chauncy S. Castle. The company proposes to operate a telephone exchange and toll lines, and manufacture electrical machinery and supplies.

HARRISONBURG, VA.—The Virginia and West Virginia Telephone Company; capital, $10,000. Incorporators, Judge William McLaughlin and others.

PORTLAND, ME.—The New Portland and Eustis Telephone and Telegraph Company will construct a telephone line over the remainder of its chartered route from North Portland to Eustis.

LA CROSSE, WIS.—The La Crosse Telephone Company, to build and operate telephone lines in La Crosse County; capital, $50,000. Directors, J. H. Moulton, W. E. Sawyer, Wm. Lohmiller and Geo. H. Gordon.

KINDRED INTERESTS

"Fuse Wire and Its Use" is the title of an interesting little pamphlet sent out by the Shawmut Fuse Wire Company, 161 High street, Boston.

The Cutter Electrical and Manufacturing Company, 27 South Eleventh street, Philadelphia, have sent out a very striking and artistic circular giving descriptions and price list of the "C-S" specialties.

The Power Station being built by the Calumet Electric Street Railway Company, Chicago, Ill., is approaching completion. The engines to be used are four 300 horse-power cross compound Ball engines, manufactured by the Ball Engine Company, Erie, Pa.

"Case Engines" is the title of one of the most artistic advertising folders that has reached us. It illustrates and describes all types of the Case engine, which is winning a prominent place in the engine field through the well directed and progressive methods of Mr. William S. Kline, the general sales manager of the J. T. Case Engine Company, New Britain, Conn.

The North Shore Traction Company, of Lynn, Mass., have placed the contract for their new car shed with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 103 feet in width and 300 feet in length, constructed entirely of iron and brick in order to have the station fireproof. The same company are also making an addition to a car shed for the Wilmington City Railway Company, at Wilmington, Del.

The Central Electric Company, of Chicago, are putting on the market a porcelain socket without a screw (with the exception of the necessary binding screw). All the parts are thoroughly and well made, and it is especially recommended to construction men on account of its simplicity in wiring. Both wires can be cleaned an equal distance from the cord knot, thus insuring the socket hanging plumb. As a fixture socket it is an improvement over anything now on the market and deserves a wide sale.

Progress of Telephony and Telegraphy.

The *Journal Telegraphique* under date of January 25, 1893, contains a very interesting editorial entitled "Revue de 1892," which describes the marvelous progress made in commercial telegraphy and telephony both in Europe and the United States. It is stated that an increase of 340,000 kilometers of line wire has taken place during the last year, while about 10,000 new telegraph and telephone stations were established, necessitating the use of 12,000 additional pieces of apparatus.

Of special interest to the American telephone electrician is that portion of the editorial which is devoted to the growth of long distance intercommunication. On that point the writer expresses himself as follows:

The progress in interurban service, though somewhat slow, is, nevertheless, constant and satisfactory. Here, as in every other great industrial enterprise, the laying of the foundation calls for a large outlay of capital. At present France is in telephonic connection with Belgium, Great Britain and Switzerland. Again, Switzerland interchanges verbal communications with Germany by way of Mülhouse and Constance; with Austria by way of Bregenz; with Bavaria by way of Lindau, and with France by way of Pontarlier. In the United States, Chicago has been interconnected with New York, a distance of 1,500 kilometers, and that line works perfectly. The only drawback we see is the high charge (45 francs) for a five minutes' conversation. According to our view such a charge obstructs the development of telephonic service over still greater distances. However, the price charged for a conversation between New York and Chicago need not discourage us; on the contrary, we hope that Chicago will be the city from which a good many surprises for the electrical engineers may emanate in the future.

May not the World's Fair, so widely announced throughout the civilized nations, originate a novel system of electrical intercommunication without conductors, such a system as has been outlined by Mr. Preece? Again, may not some invention be divulged at the Exhibition to justify the remarks of Prof. W. W. Jacques before the German Technological Society of Boston, October 6, 1892, that in future we shall instantaneously reproduce at a distant station *fac simile* messages, pictures, or photographs? Such an invention would bring about a revolution in our present methods of telegraphic inter-communication; it would prevent the frequent telegraphic errors in transmission and overcome one of the greatest troubles with which our present telegraph administrations have to contend. It should be remembered that recently Messrs. Edison and Kenny have taken out patents for a *fac simile* telegraph.

Assuming that some such important new discovery were to be given to the world at the Chicago Exhibition, it would in our opinion be an admirable twin issue to the telephone revealed to the visitors at the Philadelphia Exhibition 15 years ago, which invention Sir Wm. Thomson, now Lord Kelvin, pronounced "the greatest wonder of the century."

A Traveling Telephone.

The introduction of general telephones in large apartment houses and office buildings is not so rapid as it should be. This is possibly due to the fact that there has been no means for bringing the telephone to the occupants when the occupants would not go to the telephone.

Here is a bright idea in the use of telephones in high buildings.

By the aid of the conveyor the instrument may be available for use on any floor of the building. The ordinary telephone set, comprising magneto bell, transmitter, receiver and battery, is mounted upon a conveyor carriage sliding between grooved sides of a light elevator structure extending vertically between the several floors where the service of the instrument is desired. The conveyor is connected by a rope passing over a pulley at the top of the elevator slides with a counterweight. The electrical connection of line and ground wires is made by spring brushes constituting the terminals of the instruments bearing upon metallic bands or strips attached to the front of the elevator frame, or, if preferred, may be effected by flexible conductors, after the manner of annunciator wires to a passenger elevator.

Suitable openings are required in the floor next to the wall where the conveyor is erected to allow of the passage of the telephone set and a tray may be attached under the battery box for carrying letters or small parcels. To facilitate movement of the conveyor a draw cord is made to extend downward from it, terminating at the under side of the counterweight. The same principle is also applied to the horizontal movement of a telephone set in establishments spread out upon a single floor, the rails upon which the carriage moves being in this instance utilized as circuit connections.

Dark Times in Bucksport.

The electric light plant at Bucksport is busted and the town has gone back to kerosene till the engine can be mended. A few minutes after starting up last night the engine was taken with a series of spasms, the parabola of the dewflicker got jammed hard to starboard, which, of course, caused the flopper to fall down on the mizzen reciprocal eccentricity gimmick, and this brought the whippletree chuck up against the governor, bent the council, and, as a natural consequence, the lights went out, as one might naturally suppose who is posted on machinery.—*Bangor, Me., News.*

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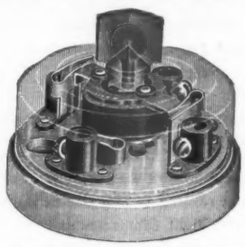
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NEW YORK.
The issue of THE INDEPENDENT for March 2d is devoted to
ELECTRICITY.
It has contributions from the following distinguished writers on the subjects named:
PARK BENJAMIN, THE FUTURE OF ELECTRICITY.
GEO. G. WARD, General Manager Commercial Cable Co., OCEAN CABLES.
GEO. S. ELY, Secretary N. Y. Stock Exchange, ELECTRICAL STOCKS AND BONDS.
Prof. F. B. CROCKER, Columbia College, ELECTRICAL EDUCATION.
Prof. GEO. F. BARKER, University of Pennsylvania, ELECTRICAL STORAGE.
NELSON W. PERRY, Editor *Electrical World*, ELECTRICAL LIGHTING.
GEN. E. S. GREELEY, Pres. the E. S. Greeley Co., ELECTRICITY IN HOUSEHOLD AFFAIRS.
W. H. BARDWELL, Librarian Brooklyn Library, LITERATURE OF ELECTRICITY.
Prof. SCHURE, Adelphi Academy, ELECTRICITY AND RAILROADS.
HAMMOND V. HAYES, Electrical Engineer Bell Telephone Co., TELEPHONES.
GEO. M. HOPKINS, Editor *Scientific American*, DOMESTIC AND ILLUSTRATIVE ELECTRICITY.
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This company owns the Letters-Patent No. 186,787, granted to Alexander Graham Bell January 30th, 1877, the scope of which has been defined by the Supreme Court of the United States in the following terms:

"The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action; the fifth, of a permanent magnet constructed as described with a coil upon the end or ends nearest the plate; the sixth, of a sounding box as described; the seventh, of a speaking or hearing tube as described for conveying the sounds; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used."

This company also owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, and controls Letters-Patent No. 474,231, granted to Thomas A. Edison May 3, 1892, for a speaking telegraph, which cover fundamental inventions and embrace all forms of microphone transmitters and of carbon telephones.

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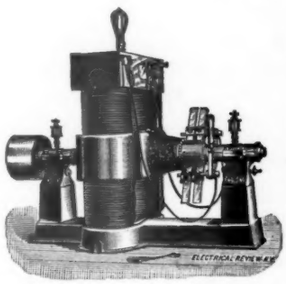

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MARCH 7, 1893.

492,394 Insulator bracket; William N. Eichberg, Chicago, Ill.

492,398 Closed electric conduit for railways; Adolph Heiser, Chicago, Ill.

492,402 Electric train-controlling apparatus. 492,403 Means for operating throttle valves of steam engines; Frank E. Kinsman, Plainfield, N. J.

492,422 Battery jar; James F. McLaughlin, Philadelphia, Pa.

492,456 Switch for operating shunt wound electric motors; Frederick H. Berry, Milwaukee, Wis.

492,457 Electric railway block system; Francis O. Blackwell, Boston, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.

492,467 Long distance electric telephony; Charles M. Haynes, Omaha, Neb.

492,471 System of combined telephony and telegraphy; Frank A. Pickernell, Newark, N. J., assignor to the American Telephone and Telegraph Co., of New York.

492,478 Electric burglar alarm; Charles F. A. Sturts, San Francisco, Cal.

492,480 Transformer and means for developing rotary magnetic fields; Charles S. Bradley, Avon, N. Y.

492,482 Signaling apparatus and circuit. 492,483 Busy signal for telephone circuits; Edward J. Hall Morris and Frank A. Pickernell, Newark, N. J., assignors to the American Telephone and Telegraph Co., of New York.

492,484 Telephone central station circuit; James L. McQuarrie, Boston, Mass., assignor to the American Bell Telephone Co., same place.

492,486 Coin-controlled machine for administering electricity; William R. Pope, New York, N. Y., assignor to the National Electric Machine Co., same place.

492,492 Electric car brake. 492,493 Automatic speed indicator and recorder; Wendel C. Fletcher, St. Louis, Mo., assignor to Norman P. Willard, trustee, Chicago, Ill.

492,497 Electric signaling apparatus; William H. Kenyon, New York, N. Y., assignor to the Hall Signal Co., of Maine.

492,519 Electric annunciator; John R. Hard New York, N. Y.

492,524 Electric motor; Franklin H. Beers, Newark, N. J.

492,526 Multiple switch for overhead trolley lines; William H. Brodie, New York, N. Y.

492,544 Lightning arrester; Charles F. Scott, Pittsburgh, Pa., assignor to the Westinghouse Electric and Manufacturing Co., same place.

492,545 Electric signaling apparatus; Werley Trafford, New York, N. Y.

492,547 Thermostatic fuse device. 492,548 492,549 Lightning arrester; Alexander Wurts, Pittsburgh, Pa., assignor to the Westinghouse Electric and Manufacturing Co., same place.

492,563 Keyed musical instrument actuated by electricity; Paris E. Singer, London, England.

492,597 Telephone tablet; John R. Pruyn, Chicago, Ill., assignor of one-half to Charles J. Miller, same place.

492,593 Detecting apparatus for coin actuated boxes; George A. Tauberschmidt, Washington, D. C., assignor of one-half to Edwin S. Clarkson, same place.

492,598 Railway appliance; James Wayland, Newark, N. J.

492,627 Apparatus for electrically propelled cars; Charles J. Kintner, New York, N. Y., assignor of one-third to Gustav Stahl, Philadelphia, Pa.

492,633 Electric lighting system; Robert W. Rollins, Hartford, Conn.

492,645 Electric railway signal; Howard St. C. Walt, New York, N. Y.

492,646 Electric alarm money drawer; William J. Walker, St. Louis, assignor of one half to Alexander L. Bedford, Savannah, Mo.

492,649 Lightning arrester; Thomas W. Wheatley, Wilkes Barre, Pa.

492,650 Electric arc lamp; William P. Wilmann, Allegheny, Pa.

492,659 Electric railway; Michel Angelo Caltori, Rome, Italy.

PATENTS

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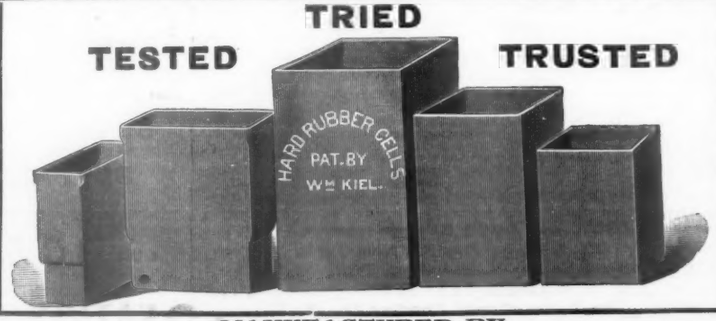

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SUPPLEMENT

TO THE

ELECTRICAL REVIEW

NEW YORK, MARCH 11, 1893,

Containing the Addresses read before the Sixteenth Convention of the National Electric Light Association, St. Louis, Mo., February 28, March 1 and 2, 1893.

Wrought versus Cast Iron for Field Magnet Frames.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY A. D. ADAMS.

(*Abstract.*)

The aim in this paper is to point out some of the advantages of wrought iron over cast iron for the field magnet frames of bi-polar dynamos.

The researches of Professor Ewing and Dr. Hopkinson show that the same magnetizing force per unit of length, as measured in ampere turns, which produces in good hammered scrap iron a magnetization of 100,000 lines per square inch, produces in good gray cast iron only about 42,000 lines per square inch, and these values are about as high as we can go in either of these metals and get anything like a proportionate increase in magnetism for increase in magnetizing force.

If, then, the same number of ampere turns are to be used for a given length of magnetic circuit, cast iron must be about two and a half times the section of wrought iron.

Since the field magnet, to have the same magnetic carrying capacity at the same permeability, must have about two and a half times the section when made of cast as when made of wrought iron, the weight of cast iron for the same type and capacity of machine will be about two and a half times that of wrought.

In order to compare the relative amounts of copper required in field magnet windings for machines of the same capacity, but with different metals in the field magnet, the same wattage or exciting current must be assumed for all types.

Take two machines of the same type and capacity, with the same length and section of air gap between the armature core and pole pieces, and let one field magnet be made of wrought and the other of cast iron, throughout, each having the field magnet core circular in section and the area of the cast iron core two and one-half times that of wrought.

Since the ampere turns required on each magnet are equal, also the watts expended in winding, there will be the same number of turns of wire on the cast iron as on the wrought iron field.

As the two field cores are circular in section and one two and a half times the area of the other, the length of wire required around the cast iron will be to that around the wrought iron core as $\sqrt{2\frac{1}{2}} : 1$.

Since the weight of copper required to transmit a given amount of electric energy at a given pressure and loss varies as the square of the distance, the weight of copper on the cast iron will be to the weight of copper on the wrought iron core as $\left(\sqrt{2\frac{1}{2}}\right)^2 : 1^2 = 2\frac{1}{2} : 1$.

The general practice among American manufacturers of bi-polar dynamos and motors is to use either cast iron entirely or cast iron yokes and pole pieces and wrought iron cores.

In the latter case the sections of the cast iron parts are usually made only about one and a half times that of the wrought iron.

With these proportions between the wrought and cast iron either an excessive amount of magnetizing force must be expended to drive the magnetism through the pole pieces and yokes, or else the wrought iron core must be only saturated to a very low degree.

The amount of copper or field current must be, in either case, considerably increased above that required when the cast and wrought iron parts have their correct relative proportions.

Magnetic leakage is considerably increased by the use of cast iron, as compared with wrought iron, by reason of the greater surface of the cast iron, also the much higher relative degree of saturation at which it is frequently used.

It is evident from the above that the weight of iron and copper for the field magnet and winding in a machine of given capacity are both more than twice as great when cast as when wrought iron is used entirely.

When the field magnet is made partly of cast and partly of wrought iron, the increase of iron and copper is not so great and varies with the relative section of the cast and wrought iron parts.

The advantages of wrought iron over cast for the field magnets of bi-polar dynamos seem to be more generally appreciated in England than with us, as nearly all the leading makers of such machines there use forged, wrought iron entirely for field magnet frames.

As the relative magnetic value of wrought and cast iron become more generally appreciated by dynamo builders in this country, the former will, no doubt, be much more generally adopted.

The following data of a two horse-power, 110 volt motor, designed by the writer, and having a forged, wrought iron field magnet throughout, may be of interest as illustrating some of the above points:

Type of motor, bi-polar.
Type of armature, smooth core, Gramme.
Weight of motor, 250 pounds.
Speed of armature without load, 1,700 revolutions per minute.
Turns of wire on the armature, 360.
Size of wire on the armature, No. 15 B. & S. gauge.
Weight of armature wire $3\frac{7}{16}$ pounds.
Resistance of armature, cold, $\frac{8.9}{100}$ ohm.
Resistance of field coil, cold, 140 ohms.
Current in field coil, $\frac{7.5}{100}$ ampere.
Wire in field coil, 26 pounds No. 21 B. & S. gauge.

Particular attention is called to the number of indicators on the armature of this machine, namely, 360, which is very small when its weight and the moderate speed at which it runs are taken into consideration.

It is very evident that these results could not have been obtained had cast iron been used, either wholly or in part, for the field magnet.

It may be pointed out that the weight of wire and the energy required for field excitation might have been considerably reduced had it been thought best to reduce the length of the air gap, but it was desired that the field exciting force should practically overcome the tendency of the armature to distort the magnetic field in the air gap, which result has been obtained by the above construction, so that no change of lead, with the brushes, is necessary when the load of the motor is varied from nothing to its full capacity.

Relation of Insurance to Electric Lighting and Power.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY WM. BROPHY.

(*Abstract.*)

It has been my good fortune to be in a position to witness the early attempts to introduce the electric light, and the attitude of the insurance companies and their agents as well as State and local boards.

Those who were disposed to give it even a half hearted welcome were very few, while those who received it as another element of destruction of property and insurance dividends were largely in the majority.

Those engaged in the insurance business and those engaged in the manufacture and sale of electric lighting apparatus, as well as those who furnish electric light and power, have one common end in view, viz., to secure at least a fair return on the capital invested in their business and for their own time and labor. Each of these interests needs the help of the other, and there is no good reason why one should antagonize the other. That this has been done in the past I will not deny, but to say that the insurance companies were wholly to blame for their hostility to the introduction of the electric light would be manifestly unfair, to say the least.

It may be said that they should have familiarized themselves with the new element, and learn how to keep it under control. The answer to that might be, to whom were they to apply for such information? Those in the electric lighting business were not overburdened with a knowledge of this subtle force, and they, being but human, could not be expected to admit, if they believed it, that it would increase the fire hazard at all, for such an admission would arouse the antagonism of the insurance companies and prevent the growth of their business. With the crude methods at first employed for the transmission of the electric current from dynamo to lamps and circuits, fires of more or less magnitude were quite frequent, with consequent loss to the insurance companies. These unfortunate happenings did not tend to cause them to look upon this new candidate with unqualified favor. On the contrary, many were inclined to look on a building equipped with electric lights as worthy of a place on the "prohibited list," while others viewed them as extra hazardous and not to be eagerly sought for by local or special agents, even at a very high rate of premium.

But in spite of the evident hostility of this powerful combination, the electric light made slow but steady progress in the good graces of the public, and while looked upon as being capable of doing more than its share to reduce dividends on insurance stocks, yet it has gained somewhat in favor with them.

How to deal with this new, and to most people's mind dangerous, element was a most serious question with the underwriters of this country. To many it seemed best to increase rates all along the line where it was introduced, and thus prevent or discourage its use. Had such action been taken, there is no doubt but that it would have had the effect of retarding the growth of the electric lighting business very greatly indeed. Fortunately, this last expedient was resorted to in only a small portion of this country.

In that little corner of our great and glorious country known as New England, the insurance organization known as the New England Insurance Exchange was most fortunate in its selection of a chairman for its then new committee on electric lighting. He found time, while performing his regular duties as a special agent, to post himself up in the mysteries of dynamic electricity, and as his knowledge increased, his friendship for this form of illumination and those engaged in producing it increased in like proportion.

The task of determining the best course for the underwriters to pursue towards it was no easy one for those who undertook it. Fortunately, they were conscious of their own inexperience and inability to give instructions until they had devoted a sufficient time in observation and study of the subject. This information was accepted, not only from the most eminent men, but from those occupying the most humble position in the business.

In this way the inspector, instead of assuming a knowledge which he did not possess, for the sake of increasing his own importance in the eyes of those who employed him, kept in touch with those whose daily experience enabled them to detect any inherent weakness in the devices and systems of transmission, and enabled him to assist in perfecting the same by advocating all improvements that increased the safety and did not impair the efficiency of the system. In this way the standard of safety has been raised to a degree that approaches perfection. In this way fire losses caused by electric current decreased, notwithstanding the enormous increase of electric light, power and railway business, and the fears of the insurance companies were in a great measure allayed.

I will try to point out the best methods to pursue to stop the silly twaddle about the dangers of electric lighting by professional agitators, sensational newspapers and timid old ladies of the male persuasion, and deprive the smart (?) insurance man, who insists that there are hidden dangers contained in every portion of the plant, that compels him to charge an increased rate of premium for its production and use of his stock in trade.

The published opinions of some of these gentlemen who do business in that smart little city sometimes known as the "Hub of the Universe," that has suffered quite recently from an unusual number of very large fires, as to the part that electricity has played in causing the same, would polarize a dynamo and paralyze its owner.

A few choice quotations are here appended:

"The Remick fire was caused by electricity." "I think there is an epidemic of fires, as in 1872, and insurance companies must yield gracefully to the inevitable. Still, it is obvious that they must have more money, and that those trolley wires must come down." "Many who were not willing to be quoted assigned the electric wires as the cause of much of the fire loss, and claim to see a connection between the growth of the fire loss and the growth of the use of electricity in the same district."

The men mentioned in the last paragraph are to be commended for their modesty in not wishing to have their names handed down to posterity as the wise(?) men of the "modern Athens."

In the city of Boston, mind you, the Board of Underwriters have for a number of years maintained a system of electric light inspection, paid for by assessments levied on electric lighting companies, also on firms and individuals engaged in electric construction. The city is compelled by the State law to maintain a similar system of inspection. In addition to this, one of the electric lighting companies, whose officers are not possessed of an abiding faith in either of the above named systems of inspections, makes it a point to inspect all wiring before they will connect thereto.

Yet with all these safeguards and checks on those engaged in electric lighting and construction, those men "claim to see a connection between the growth of the fire loss and the growth of the use of electricity."

The real fact in the case is that millions of insurance has been placed by the agents and brokers on property that has been far more hazardous than the very poorest electric light plant in the business portion of the city in question; ordinary prudence having been thrown to the winds in writing such insurance, the inevitable consequences of such folly ensue, viz., disastrous fires. The agent who sees a possible loss of commissions hastens to give a plausible excuse to his companies by charging the orgin of the fire to electricity, and demands an investigation of the fire department for not extinguishing them before they were kindled, concealing the fact that his own methods of placing insurance encourage incendiarism and promote carelessness.

In view of the fact that it is now proposed to add a small charge to the rate of insurance where electric lights are "installed in compliance with board rules and specifications," and a charge of 25 cents where they do not meet with the approval of the insurance inspector, I would advise you to pursue the following course:

Where a company does its own wiring for its customers, proceed with as much care as though the building in which you are installing wires and fixtures was your own and you had no insurance on it. Where the work is done by others, inspect every foot of wire, every joint, cut-out, switch and insulator, and on no account turn on current until you are satisfied that it is as safe as it is possible to make it. Do not rely on the uncertain movements of the insurance inspector or any other system of inspection that too often fails to inspect. You are the

one whose business will suffer from the bad effects of fires caused by defective wiring.

We now come to the electric light station. Do not rent one end or the basement of a flour, saw or planing mill, and place your machinery in it, and expect to get any better than the rates charged on the buildings named above. While they are considered extra hazardous risks, insurance boards in their wisdom(?) will tell you that the introduction of electric light machinery increases the hazard and also the rate. This statement may cause you to smile, but there are those whose early experience have found it no laughing matter.

Do not place it in some old abandoned building, for, as in the above case, an increase of rates will follow. Do not set your machinery down on the ground and build a tinder box around it, for besides assuring high rates of insurance, it does not speak well for the business sagacity of the owner.

Proceed as though you propose to do a legitimate business and for all time. Build your station on solid foundation, the walls of brick or stone, not over two stories high—better only one—solid brick or stone foundations for engines, boilers, dynamos and pumps; a solid brick wall extending three feet above roof between boiler and engine room; the floor of boiler room of brick, stone or cement; if building is two stories high, have the boiler room the same, having clear, open space between floor and roof; floors of engine room, if dynamos are not placed therein, can be of iron or stone; if dynamos and other apparatus are in the same room, floor should be of three-inch plank, tongued and grooved, with hardwood floor of one-inch boards, matched and laid at right angles to, or diagonally on, the plank, the whole laid on heavy square timbers or iron I beams; the roof should be of three inch plank, splined and grooved, resting on square, hard wood timbers or trusses of iron or I beams; cover this with slate, tin or gravel, according to pitch; leave the walls bare; do not attempt to improve their looks by covering them with wood and creating concealed spaces; roof and ceiling, ditto; enclose stairways with plank, and provide self-closing doors therefor; cover the doors in brick partition walls with tin; also the frames; do not build a wooden hen-coop or Turkish pagoda on top of roof, and call it a wire tower; build from floor of dynamo room, of brick or tile, a good substantial tower, of ample size for all wires; put them in systematically and not by guess; make switchboard of good, hard, well seasoned wood, skeleton in form, or use the sides of brick or tile tower; if slate switchboard is used, bush all holes through which wires, plugs or other connections carrying high potential currents pass, with glass, porcelain or hard rubber; do the same if sides of brick wire tower are used; use this same material where wires pass through floors or other woodwork; secure a supply of water for protection against fire from town or city mains, if available and pressure is sufficient. In doing this have pipe leading into station of ample size. It costs no more to excavate for a six-inch pipe than it does for a one-inch, and the difference in cost of pipe is not enough to outweigh the value of an abundant water supply in case of fire, for, like the Texan's revolver, then is the time when you want it and want it bad. If water cannot be secured in this way, make your boiler pumps sufficiently large to throw, when connected together, or working singly, from three to five hundred gallons per minute, according to circumstances. Remember that all electric apparatus, including dynamos, is very susceptible to damage by fire or water, and by reducing the amount of combustible material in your plant you reduce the possibilities of a large fire and the necessity for a large amount of water.

Do not, if possible, build your station adjoining or too close to such risks as oil refineries, planing, saw and flour mills, grain elevators, etc. If obliged to do so, have no, or as few openings as possible in the exposed side or end, and provide metal covered shutters for these few. Run all your wires in plain sight, leaving ample space between them.

In planning your station, allow for future growth and enlargement, without disturbing the present arrangement of machinery, etc. Store your oil, and, if possible, your other supplies, outside the station, and if you have a repair shop, do not have it in the second story, attic or basement. It is much better outside the building. If you must have it in the building, do not box it up out of sight, but separate it, if you must, by an open partition or fence from the rest of the building.

Divest your own mind of the idea that dirt, grease and slush must be the wedded partner of an electric light station, and impress on that of your employés that an absolute divorce must be granted if the marriage ceremony has been performed. "Cleanliness is next to godliness," but nowhere does this maxim apply with such force as in an electric light station.

Having finished your plant in accordance with the foregoing requirements, you need have no fears of acts of unneighborly conduct or apparent neglect of your property by the ever active insurance agents. Instead of waiting for you to seek them out and beseech them to insure it, they will be as attentive to you as the most ardent young suitor ever was to his lady love.

Some Experiences with the Alternating System.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT ST. LOUIS, MO., BY R. H. STERLING.

(Abstract.)

I will take the principal features of an alternating station in detail, describing what have been our results and the best practice in my experience.

I will begin with the switchboard—a subject often discussed in these meetings, but none the less important—and I will try as much as possible not to go over the same beaten track, with possibly some new details. A circuit board is eminently better made of marble, as a matter of both safety, durability and appearance, and should have plenty of space between it and the wall. The dynamo bus wires should run in horizontal rows on the back, with plug holes extending through to the front, to connect to either side of each changing switch. There is a changing switch, of course, for each feeder or circuit, and all bus wires can be connected to any particular feeder. The front of the board should be divided into perpendicular panels, each panel representing a feeder.

On the back there will be the converter for voltmeter, compensating devices, etc., and the fuse blocks. These are preferably placed on the back, as it is an unpleasant thing to have a fuse blow in a man's face, and they should not be so high on the board that they cannot be reached standing on the floor. Many of you, undoubtedly, have had trouble with a fuse arcing, and finally melting the fuse block into a conglomerate mass, or setting fire to the switchboard. There are two simple remedies for overcoming this; one is to have all fuses covered with a piece of asbestos paper rolled around the fuse wire or link in the form of a tube, a little larger on the inside diameter than the wire, to allow for radiation of heat, so that the fuse will not melt under its rated capacity. These asbestos tubes are very easily made, and can be pasted either with shellac or silicate of soda, which is preferable, the idea being that when a fuse is blown, the pent-up gases in the tube are forced out at either end so violently that the resulting arc is dissipated immediately. I believe I am not the originator of this idea, but believe we can claim the use of asbestos as our own, and which is the only substance that is practicable.

Another simple plan to prevent arcing is to have all fuse blocks placed on a narrow shelf, with their faces up, as there is always a tendency in an arc to take an upward direction, owing to the current of heated air resulting from it, and in taking this direction there is a natural pulling away of the arc from the two metallic portions of the fuse block; whereas, were it in a perpendicular position, with the current usually coming in at the bottom of the block, this upward tendency of the arc only completes the path across the gap, and so continues arcing. Fuse wire as now made is quite reliable as to its carrying capacity, but, like many other good things, is not trustworthy if abused. A lead fuse, either wire or flat link, should never be screwed down under a screw head and washer, no matter how small the carrying capacity it is intended for. This may do for a short time, but the soft metal soon loosens up, a poor contact is formed, and the fuse melts from the heat thus generated, causing no end of annoyance. This applies to fuses, no matter where they are used, all over the circuit. The one way out of this is a small, flat copper terminal, slotted to slide under the screw head, and soldered to each end of the fuse wire. The carrying capacity of the wire can be stamped on one terminal. These are cheaply made. A boy with a punch and die can stamp out many hundreds of them in a day, and the soldering, with a little experience, is rapidly accomplished. Had we adopted these fuses when we first began to furnish light, five years ago, and insisted on all inside wiring being fused in this manner, we should have been many dollars ahead to-day, and there would have been fewer lights out during that time.

Nine-tenths of the calls on our complaint book show a record of fuses blown in branch or main blocks of inside wiring, which we have to send men out to replace, and from repeated inquiries from these men I find that this same proportion of nine-tenths would hold good for fuses that had blown or rather melted from poor contact, due to lead becoming loose under screw heads, and from no cause of short circuits, overloading or trouble in the wiring. We now compel all wiring contractors to use a copper terminal fuse, and we ourselves replace all blown-out ones with this style; but with 75,000 lights connected up, we do not see our way clear to weeding out the old fuses just at present; so let this be a warning to those young in the business.

On the front of the switchboard we have for each section or panel a volt and ampere meter for every feeder, one over the other, and surmounting these a pilot lamp run from the converter supplying the volt meter, whose primary should be tapped on the feeder wires above the fuse block, so that should a fuse go out quietly, as is generally the case when fuses are arranged in the manner I have mentioned, the attendant's attention will be called to the fact by the extinguishing of the pilot lamp. The changing switch, generally placed on the front of the board for each feeder, should be about breast high, so as to be easily reached to make a quick throw. I say usually placed on the front of the board, as it is only recently that a new switch has come out that has its jaws and contacts so arranged that it can be placed on the rear of the panel, with the lever extending through a slot to the front of the board. This is a matter of great safety to the switch tender, for, as stations increase in size and load, a new element of danger sometimes manifests itself in the act of throwing these changing switches. A violent arc is formed which follows across from one set of contacts to the other, throwing two dynamos in multiple through the medium of this arc, burning the attendant's face and hands, and sometimes wrecking an armature, as, of course, the two dynamos are not apt to be in synchronism when thus thrown together. Placing the switches horizontally will lessen greatly the continuance of this arc, on the same principle that I have mentioned the placing of fuse blocks on the switchboard with their faces up, and a fibre or slate partition between the jaws will prevent the arc short-circuiting the dynamo. This annoyance is only met with on feeders of considerable length and those having a large number of converters on them. It is due to inductive discharge from converters and line, and is similar to the extra current or field discharge of a dynamo. Its occurrence depends largely upon the period in the wave phase at which the circuit is opened, and is proportional to the length of the circuit and the number of converters connected on the line. I have found this discharge to occur more frequently on circuits whose converters were partially loaded. This would naturally seem to be the result when the secondary coils of the converters were exerting no action on the primary, but I have had the most severe arcing on circuits with heavy loads. The damaging result of these arcs, however, has been entirely diminished since placing the switches horizontally, as I have described. I have spoken only of the feeder ammeters. There should, of course, be an ampere meter for each dynamo. These are preferably placed together in a group at one end of the board, so that at a glance the attendant can see what load he is carrying, or on what dynamo there remains room for more feeders as the load comes on or goes off. The regulators and rheostats can be placed at the base of the switchboard, or, much better, if there is room, in a compact row out in front of the board about four feet, on a strong framing of wood or iron, so that all the voltmeters can be watched at the same time that the adjusting of the pressure is taking place. This saves the annoyance of the attendant jumping from the rheostat out to the front to catch a glimpse of the voltmeters to see how near he has come to guessing at the right amount of resistance he should have thrown in or out. The result will be far better service if the rheostats are thus arranged.

This now brings us up to the remaining feature of the switchboard—the lightning arrester—though I cannot say that, necessary as this last-named appliance is, the switchboard is the all-important place for it. There may, however, be a lightning arrester on each side of every feeder, placed in a row on the top of the board or on the wall back of it, and a heavy copper wire running along past this row and connected to each arrester with a tap wire, and the main wire leading to a good ground in as straight a path and with as few crooks and turns as possible, as every bend offers a source of self-induction detrimental to the flow of the lightning discharge. The source of ground cannot be too perfect; have several of them radiating off to different points, to a mass of metal in a well, or soldered to a water main, so, should one fail, the other may be relied upon. The lightning arrester itself should be an instrument devoid of fuses, be capable of rupturing instantly the arc formed, and still remain set for a second discharge; should be free from all moving parts; not absorb energy, and should be so reliable and substantial that they could be set up anywhere on the line and forgotten, and still perform their duty. This may seem to you like an ideal instrument, but, so far as alternating currents are concerned, I am positive that this state of perfection has been attained in a certain arrester now on the market. There is no question about the efficacy of lightning arresters placed out on the line, if we wish to keep the lightning out of the station and protect our converters, especially in districts remote from other wires and tall buildings, as in the residence portion of lighting. It is a good plan to place one at the end of each feeder and branch main, and scattered at intervals midway on the circuit; they also are a wise protection over a large bank of transformers, notwithstanding the fact that we are taught to believe that lightning abhors an inductive resistance as nature does a vacuum, and that a collection of such resistance would be self-protection, yet it does not prevent the discharge entering the case of the converter; then it does not have to jump much more than the space of one-eighth of an inch over to the plates to ignore these inductive coils, reach the secondary outlets, and thence to the house wiring, when it generally finds an easy path to earth with the close proximity of inside wires to gas and water pipes, and especially on combination fixtures with poor insulating joints. This does not always completely burn out the converter, as oftentimes this discharge has only ruptured the primary coils on the first turn of the wire at the point where it has jumped to the frame holding the plates, and is easily repaired. I imagine this is the case when a discharge takes place when there is no dynamo current on the lines; at other times there is a complete destruction of both coils. In a great many instances we have traced converters burned out by lightning to defective insulation in the house wiring. Whether the ground actually existed before the disruptive discharge, or was caused by it, we could not always tell. I did find one place where the wire was fused to a gas pipe up in the attic, the discharge evidently having jumped through the insulation, as the wire had been carelessly left resting on the pipe. Of course, the primary fuse, having blown in the burning out of the converter, did not leave the circuit permanently grounded. We do not want the house wiring a safety valve to relieve the circuits of their static charges, therefore, having lightning arresters, plenty of them, that will offer an easier path to earth across small arcing gaps, smaller than can be found in the converters; but no matter how perfect the arrester is, it is valueless unless it has a good ground connection and a straight copper wire, not smaller than No. 6, without bends or turns, connecting the two. A very convenient method I have found to make a reliable earth connection for arresters out on the lines is to dig a hole at the foot of the pole about two feet in diameter, three feet deep, and driving down through it a 12-foot length of 1¼ inch galvanized iron pipe, having on the lower end a driven-well point to allow it to be driven easily, and a cap screwed on the upper end to prevent the sledge hammer splitting the pipe. The No. 6 wire can be more thoroughly soldered to the pipe before it is sunk. The upper end should be driven to about one foot below the surface, and the hole filled in with finely broken coke, which increases the conducting surface at that part of the earth that is the dryest, and the lower end of a 12-foot pipe will usually be in moist earth, and can be relied on to furnish good connection at all times. I once had an electric light man tell me that he considered a small coil of wire buried just under the surface of the earth sufficient grounding, as the rain would immediately soak the earth and make all the ground he wanted. I have observed severe lightning discharges that took place before a drop of rain had fallen.

While on the subject of the burning out of converters, I will mention an annoyance we sometimes meet with in a primary fuse blowing, arcing and welding the leading-in wires to the case, or so carbonizing the fuse box that a short-circuit is formed on the line. This will always be the case where a fuse carrying a high potential current blows in a pent-up space, with no chance for the gases to escape. The arc is being fed, and increases until a fuse is blown at the station and shuts off the supply of current. Generally, on throwing in this feeder again, after replacing the station fuse, it will be found to work all right if the wires are not fused to the converter case, or everything is not carbonized inside. We have in some instances, on its again blowing the station fuse, fused up a little heavier and finally removed the trouble, not fusing to that extent that it would wreck the armature. We are learning now that it is far preferable to have no primary fuses in the converter case, but a large primary fuse and switch box combined, removed from the converter to protect it. We have long since discarded secondary fuses in converters, replacing them with copper wire; and let me remark here that this is what a member of this Association meant when he made the statement before one of its conventions that we had been substituting copper wire for all our primary fuses, he evidently mistaking the primary for the secondary end of a converter.

This would also be a sad mistake to make when fooling with hornets.

This short-circuiting of the line by the burning out of converter fuses and other causes led me to adopt a combined switch and fuse box on all branch lines leading from the main feeders, and we have found them of immense benefit.

The switch cuts off all connection from the line wires in fusing up, and also makes a convenient means of disconnecting that part of the circuit to locate grounds and other trouble. Then the greatest usefulness is their blowing when there is a short-circuit on the branch they protect, thus preventing every light on the rest of the circuit going out by the station fuse blowing. Then, again, it locates at once where the trouble lies by sifting it down to one of, say, twenty branch mains, by telephone calls pouring in that lights are out at such a place.

As alternating stations increase in size, and larger units of dynamos are adopted—which is certainly a wise step towards economy—another class of appliances are required at the switchboard, namely, devices for independently regulating the state of pressure on any particular feeder, the dynamo pressure remaining the same. The necessity of this can readily be seen, for we will have, say, on the same dynamo, when it is of large capacity, several feeders of different loads; those carrying the greatest number of amperes requiring a higher electromotive force to overcome the drop on line, so that if this required pressure all came from one source, these feeders of lighter load would be receiving too much potential, and a large lamp breakage would be the result. Therefore, the potential of the dynamo is regulated for the lighter feeders, and pressure raisers or "boosters" used to bring up the potential still higher for the remaining feeders. The principle of these regulators is this: If we take a converter whose capacity equals the maximum load of the circuit and connect the secondary in series with one side of the feeder, and the primary across the two sides, we are then adding the 50 volts of the secondary of the converter to the 1,000 volts of the line, raising its initial pressure five per cent. Adding a number of these in series in like manner, and having a suitable switch to throw them in or out in succession, makes a very convenient means of raising the voltage, but resembles somewhat, as I once heard it remarked, a man raising himself up by his boot straps. I have sometimes found it very useful connecting in ordinary converters at the switchboard, for temporary heavy loads, in this manner, where feeders were not provided with the regular "boosters."

Reactive or choking coils may be employed instead of "boosters," with the same end in view—*i. e.*, the proper adjustment of pressure on feeders of unequal drop supplied from one source—only in their use they will be placed on the lighter feeders and the dynamo be made to raise the electromotive force for those having the heavier load. The first cost, I think, would be in favor of the reactive coils, but the relative economy in energy consumed would be slightly in favor of the pressure raisers.

A serious annoyance is often met with on the line from the inductive effect of two parallel circuits upon each other, causing the lights to waver, or "pump," which better expresses it. When this trouble first manifests itself in a station, the engine is generally the first thing to be blamed, and the engineer is caused many sleepless nights or days in trying to remedy it.

We seldom find this effect in small stations, unless the feeders are parallel to each other for a considerable distance. It is most marked in circuits that are parallel and one of them carrying a heavy load, which exerts this inductive influence on neighboring lines, on the same principle as the primary coil of a converter, inducing currents in the secondary parallel to it; only in the case of this action on the lines, where each line is fed from a separate dynamo, their phases, of course, not corresponding, we have in this cross-induction a very unsteady action in the current. Annoying as this trouble is, it is one of the easiest to remedy. First, see if some combination on the switchboard will not bring about a change in affairs. Ascertain if the several lines on which this trouble is noticed cannot be all run on the same dynamo; but if this should cause this induction to appear on other circuits formerly free from it, the then remaining way is to transpose the circuits midway between the starting point and where they cease to run parallel, by inserting a break arm in each side of the line, and joining in the shape of a cross the four ends thus formed. This will neutralize and break up the trouble completely.

The Atlantic Avenue Railroad Company, of Brooklyn, have received their first instalment of cars from St. Louis. The cars are finished in white and gold. It is declared by President Norton that the trolley will be in operation on all the lines of the company by June 1.

Long Distance Transmission of Power.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY CHARLES S. BRADLEY.

It is supposed that there was a time when man did not know of fire; that it was a discovery, and great must have been the discoverer among his fellows if they did appreciate the importance of combustion, as we now call it. Without it, man could not exist in these colder climates and must have hovered about the equator. It now not only provides us with a means of comfort in the winter's cold, but also gives us light and power. The last decade has given us this light and power in much improved form by the aid of that silent, mysterious agency, electricity. If one has to go into the woods and cut his own wood to keep warm, almost half of his time is taken up in the chopping and hauling; so, too, in supplying the fuel to a steam engine, much labor of human hands is required, especially if the source of fuel is distant from the point of use. By organization, by careful preparation and the construction of permanent works, how wonderfully man increases his comforts and reduces his hours of toil. If a man were to try to light his house with incandescent lamps, and do it with his own power, his whole energy would be consumed in one light. If he were to try to propel his own lathe he could turn but a small one, and leave himself no leisure time. It now lies within our means to build an electric transmission of power plant from coal mine to city, which shall cost $300,000, and will transmit 5,000 horse-power; this plant will do the work of 30,000 men steadily day and night, year in and year out, and once placed will last a lifetime. The $300,000 represents the work of the 30,000 men for about four days, or an outlay of $10 each; thus these men can build a plant in four days that will do more work during their whole lives than they can. Can anything appeal to the imagination of man with more force? The energy of 5,000 horses transmitted noiselessly over a small wire, the coal from the mine placed by one act immediately beneath the boilers, the energy thence running to its destination without any labor from man; the air to supply combustion taken in the country, thus not robbing the human being gasping for breath in the city; the smoke and foul gases being thrown off where they will do no harm. Think of a city free from smoke, its cars, elevators, shops run and lighted by electricity which shall be generated miles away. I have not said houses heated, but I hope that before 1900 we may say this also. The present obstacle to heating by electricity is the inefficiency of the steam engine. Many are looking for the direct conversion of the energy of coal into electricity. There is no doubt that it can be done, but I fear it will never be economical, for we must depend upon the combustion of the coal in the oxygen of the air. The oxygen is just as necessary as the coal, but, being ever present, people neglect to consider how important it is. There is no other element in nature which can replace oxygen for this use. The only way we can get the energy at low cost is by the chemical combination of these two substances—coal and oxygen. The ordinary combustion where the air passes through the coal admits of the production of heat only; for the electrical resistances, although the spaces may, by inventive genius, be made as small as the atoms themselves, will be so great as to prevent any commercial current from flowing. The thermopile offers a way to use heat, but when heat has once been produced we cannot expect to convert it to a higher form of energy without great loss. If we solve this problem, we must catch the energy as it issues from the chemical combination. The only way now known to man of converting chemical energy directly to electricity is illustrated in the primary battery, where a conducting electrolyte forms a path for the current, and at the same time carries the elements that are to be consumed toward each other. This to all appearances is inherent. It necessitates that the oxygen shall have abandoned the gaseous state and entered the liquid. The coal demands for working a high temperature; therefore, the oxygen must have entered liquid condition and stays so at high temperatures. There are substances, such as permanganate of soda and the chromates, that seem to approach very close to filling these requirements as an electrolyte; that is, they will at high temperatures absorb oxygen from the air. They will also act chemically on the coal and produce a current. But now we are coming to the limitation again. The specific resistance of these substances is too high and the electromotive force too low, being between nine-tenths and one volt, to give a reasonable amount of power from a given size of apparatus. The most promising of all fields to increase the efficiency of the conversion, I believe, lies in the gas engine; the atmospheric gas engine of Otto Langen having reached the high efficiency of 72 per cent. In this engine the piston is allowed to shoot up by the explosion and do its work in the descent. There seem to have been mechanical difficulties in the way of the success of this machine, but these can be overcome. Then, suppose we have an efficiency of $\frac{7}{10}$ in an engine and 75 per cent. in transmission, we will have, all told, 54 per cent. of the energy of the coal delivered to point of consumption, which will make electrical heating not only possible, but preferable to any or all other forms. Thus we may hope at no distant day to burn all coal necessary for the uses of a great city at the mine. Farther, we may take from the coal first its chemicals, which have become so valuable in the arts, then use the balance as gas in our engines.

For the electrical transmission of power we have two general systems, the alternating and the direct. The multiphase alternating was advertised extensively by the Lauffen-Frankfort plant in 1891. This pioneer plant was built by much sacrifice of time and money, and we owe gratitude and honor to these men whose indefatigable efforts accomplished the beginning of an art which is destined to revolutionize the social status of mankind. This plant proved conclusively that very high voltages could be successfully used and the insulation maintained. This is the whole thing in a nut-shell; the choice of this or that particular way of generating and using the energy is of secondary importance, and will vary with each situation; surprising as it may seem, the maintenance of the insulation was the least trouble in the operation of this plant. One of the greatest, the interference with the telegraph which belongs to the German Government, and when the German Government says "stop," it means stop (in Germany). The next difficulty in importance is the static induction, each wire, being so long and exposing so much surface, becomes a reservoir to hold electricity, and the generator must fill this reservoir on each impulse before it can deliver energy at the distant end. When the generator reverses the direction of current, as it does some 100 times per second in the alternating, this reservoir must be discharged and filled with electricity of opposite sign; that is, if the first impulse to a given wire was positive and fills its capacity with the positive electricity, the reverse impulse must discharge the positive and then fill the reservoir with negative electricity. This operation consumes but little power; it is an ebb and flow, as it were.

The trouble, however, is that this idle current swinging back and forth occupies the carrying capacity of the generating apparatus; so much so, that I saw the fuses blown at Lauffen with no load of consequence at the Frankfort end. In damp weather the insulators become wet on the external surfaces, and this largely increases the capacity, which is more serious than the increased leakage. These difficulties vary with the length of the line and the amount of power transmitted, the surfaces being proportional to the length of line. The carrying capacity is proportional to the square of the diameter of the wire, while the static capacity is proportional to the surface, which is equivalent to being proportional to the diameter, so that the larger the amount of current transmitted the less proportional influence the static capacity has. These things must be determined by the engineer in each case. The Lauffen-Frankfort was an extreme case. First, the line was much longer than we shall expect for some time to come in practical work; second, the plant was intended for 300 horse-power and a rate of 40 phases per second. Owing to the static effects at 40, the rate had to be lowered to about 23 per second. This obliged them to run the dynamo at very much reduced speed, so that it was capable of only about 100 horse-power, and this reduction increased the proportion effect of the static charge. In long distance transmission the lines should be carried on poles whenever it is possible, for the farther apart the conductors are, the less will be the inductive capacity; if placed underground, they will of necessity be near together. The placing in separate conduits to gain distance will not help, for the nearness of the earth is the equivalent of the nearness of the conductor of opposite sign. These things are only warnings, however, and slip out of sight with proper precaution. The multiphase alternating is the most pliable, adjustable system that has ever been conceived. It fairly entwines itself about the electrical engineer's heart. It is capable of transformation in voltage; will supply motors of either synchronous or non-synchronous type; will readily convert in motor transformer to direct current for electric railroad or direct current distribution, and thus supply direct current motors. A patent was issued to me October 2, 1888, which covers this ground, and it is surprising and gratifying to read the original specification filed April 23, 1887, now nearly six years ago, and note there the complete provision for the transformation for these varied uses. At the factory of the Fort Wayne Electric Company I have had exceptional facilities for experimentation on the multiphase systems, some 270 different tests having been made on motors, dynamos and transformers, the record of which fills a respectable volume. If this could be given to the world, that the engineers might know what not to do, undoubtedly the wings of many a genius would be clipped. Where the power is to be delivered in compact form the direct current offers some important advantages. We can get very high voltages by a battery of machines placed in series for the generator and motor stations. The placing of machines in series for power transmission was proposed by Mr. Edison in 1880 and Prof. Thomson in 1883. Each contributed some essential improvement, but it is evident that the enormously high voltages now contemplated were not then thought of. For the generator station I prefer compound wound machines—first, that the system may be self-regulating; second, that the series coil, when a machine is thrown into action, shall magnetize the field in the right direction. This also requires that the switch shall close the series coil first. The shunt coil would tend to reverse until the machine has attained electromotive force enough to overcome the resistance of its own armature. In order that each machine shall be as far as possible independent of its neighbors, I prefer that it shall be short shunt, or, in other words, the shunt coil be charged direct from the brushes of each machine. I would use the 500-volt machines, and of such ampere capacity as the size of the plant demanded, and belt them all from one shaft. The 500 volts have been found safe to life and the commutator works well. Now, we must protect the insulation of the windings; the end machines, where the terminal voltage, say, reaches 20,000 volts, may, in case of grounds, be subjected to the piercing strain of the entire electrical pressure. It is impracticable to insulate the windings of each machine to stand any such potential; therefore, we connect the windings of the machine at some point with the frame, so that it may never be subjected to a strain greater than its own voltage; next, each machine foundation is thoroughly insulated from earth, and in case this insulation fails for any reason, the fuses of the line will be blown, thus protecting the whole structure. It is easy, however, to make this foundation insulation so perfect that no derangement will take place. For this I have struck upon a cheap plan, which was not apparent at first. Having now provided for the insulation, we must next consider the safe handling of the machines. A moment's consideration of the electrical potential of each successive machine in the series will make it evident that the whole of each machine will attain the potential of its individual position; or, beginning at one end, each successive machine will be 500 volts above the preceding one. Now, it is a well-known fact that a man may be charged to a high voltage without any inconvenience. An illustration of this is found in the stool with glass legs that we used to stand on in school and be charged up until our hair stood on end. The danger to life comes from the passage of a current through the body. Now, like standing on a stool with glass legs, a man may be placed upon any one of these machines, and if he cannot touch any conductor to earth, he is perfectly safe. We can use a wooden platform around and attached to the base of the machine, so that the man must cross it before he lays his hand on the metal part. Here, again, I want to point out how essential it is that the windings be in metallic connection with the frame for the safety of the man. It secures that no part of a machine shall exceed its own voltage, and in case of a leakage in the foundation insulation, immediate detection. If this metallic connection were not provided and a leakage occurred in the foundation, you will readily see that it might be undetected, and a man touching the brushes and the frame would take a current through him of uncertain high voltage. At the motor station we use simple 500-volt shunt machines with the same precautions as at the generator station. Our power having been transmitted, can now be converted into whatever may be demanded. If it is an electric system of distribution, we shall have the advantage of its being impossible for the high tension current to get into the system of distribution. If it is a large plant, the motor station may be subdivided into two or three parts, preferably in multiple arc, with the same potential on each. On very long lines I think the transmission must be done by direct current. To prophesy, although a temptation, is futile, for the lines of progress are not as one man would think, but as the multitude of surrounding circumstances determine.

An estimate of the actual amount of horse-power used in North Tonawanda, N. Y., has been compiled. It shows that there is a daily consumption of 11,000 horse-power in the city.

Remarks Concerning Power Transmission from the Economic Standpoint.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY L. B. STILLWELL.

At the Buffalo Convention of the National Electric Light Association, in February, 1892, in the general discussion of the subject of electric transmission of power, a great deal was said about different systems of electric apparatus which might be employed for this purpose, and various opinions were expressed concerning volts, amperes, cycles, alternating versus direct current systems, and one-phase, two-phase or three-phase machinery. The subject appeared to be one of great interest to the convention, and the discussion was more or less instructive. But the writer carried away from that convention the impression that after all, the manager or owner of a central station, or the business man desirous of securing information as to the practicability of profitable investment, must have failed to derive any great amount of information of the kind which he desired to obtain. The first question of such a man is "Does it pay?" and it is a question which an engineer who has become so involved in the consideration of technical points as to lose sight of the question of practicability from a business standpoint has great difficulty in answering. But the business man is right. "Does it pay?" strikes direct at the whole matter. The practicability of all systems, and of all projects of this description, must be measured in monetary units, and electric transmission of power, as well as every other form of engineering undertaking, must find its ultimate reason for existence in considerations of economy. Any engineering project which cannot live when measured by this standard should never be undertaken.

In discussing the subject briefly from an economic as distinguished from a technical standpoint, I wish to say at the outstart that I am aiming to obtain information rather than to impart it. The question which the practical man asks as to the economy of a project is the most difficult to answer. No answer that is perfectly general, and at the same time, definite, accurate and infallible, can be made. The problem broadly considered is one of extreme complexity, comprising a large number of factors, and these are nearly all variable, whose actual values for any given case depend upon a variety of local conditions, the precise effect of which is not easily determined. Very few men, even among those who are actually operating central stations, are able to say exactly what power costs them, and it is not surprising that the engineer who is called upon to lay out, let us say, an elaborate plan for the utilization of water power finds it difficult to give explicit answers to questions relating to the cost of operating such a plant, probable revenue to be derived from the sale of power, and, in general, economic feasibility. It is safe to say that no perfect general solution of the economics of central station operation can be worked out. Time, and the sure working of evolutionary law will some day clear away much that in the early days of a new business is inevitably more or less uncertain and speculative, but it is not to be expected that we shall even then be able to reduce these matters to fixed formulas. Of 10,000 plants the fittest will survive and pay dividends, and central station engineering will then consist of close study and careful analysis of the conditions and methods which have led to the survival of these fittest installations. In other words, central station engineering will then be largely imitation.

At the present time we find in actual operation a large number of central stations utilizing the energy of coal by means of steam plants, and distributing power and light through the medium of various types of electrical apparatus. The number of central station plants operated by water power is, on the other hand, extremely limited. There is to-day perhaps no question of greater interest to owners and operators of central stations than that of the relative economy of transmission plants utilizing water power, and it will, therefore, be interesting to narrow the general problem of economics of central station operation in such a manner as to indicate how experience in the operation of the former class of plants may be made useful in predicting what will happen if water power be substituted for steam. The best way to arrive at results of some tangible value is obviously to compare a hydraulic and electric transmission plant with a central station using steam engines to drive dynamos.

In the former we have the steam plant, consisting of boilers, engines, pumps, heaters, etc.; the electric generating plant comprising dynamos, exciters, and all electrical apparatus located in the central station; and the distributing plant comprising motors, lamps, transformers, and the conductors connecting these with the central station. In the latter case it is usually convenient to locate a sub-station at a point adjacent to the market, for example, on the spot where the central station would be located were we to obtain power from coal. In such a plant we have the hydraulic apparatus, comprising gas, fluxes, draft tubes, turbines, regulators, etc.; the electric generating plant, consisting of generators, exciters and all electrical apparatus located in the generating station; the transmission circuits between generating station and sub-station; electrical apparatus in the sub-station, which usually consists of transformers employed to reduce potential, together with switching and regulating apparatus; the motors, lamps and other translating devices, and the local distributing circuits connecting these with the sub-station. We may assume that the two installations, from the point where the local distributing circuits leave the generating station on the one hand, and the sub-station on the other, to the premises of the consumer, are, precisely similar. There is no reason why they may not be so, and since the whole installation, no matter which of the two alternative plans is adopted, must be designed to supply such service as the customer wants and will pay for, the assumption is perfectly fair. It follows that if the two contrasted plants are capable of delivering the same amount of power to the local distributing circuits they are alike as regards revenue. We may, therefore, at this point make our comparison still more direct by further narrowing the problem, disregarding the revenue side of the question, and comparing simply annual charges. It is obvious, also, that it is unnecessary to compare annual charges upon that part of each of the contrasted plants which lies between the customer and the central station in the case of the steam plant, and between the customer and the sub-station in the case of the hydraulic and electric transmission plant. In other words, that phase of the general problem which I have selected as perhaps the most interesting may be stated as follows:

"What are the total annual charges against a hydraulic and electric installation utilizing cheap power at 'A' and transmitting it to 'B' as compared with the annual charges against a steam and electric plant located at 'B,' and capable of supplying the same amount of energy in equivalent form to the local distributing circuits?"

We may conveniently construct an algebraic skeleton or framework of the annual charges against each of these typical installations. When we come to translate algebra into arithmetic by substituting numerical figures for the algebraic symbols, opinions will differ widely as to the actual values of the different factors, but I think that the skeleton will be useful, as, by discussing, and, if possible, fixing one factor at a time, we shall be better able to arrive at some approximation to a definite and tangible result. The method outlined in the skeleton framework is, of course, the method which a competent engineer, who may be called upon to make estimates of the operating expenses of such plants, will adopt; that is to say, he will naturally consider each item of expense separately, and make his calculation step by step. But the proper factors largely depend upon the results of experience in the operation of plants sufficiently similar to make inference from one case to the other fairly safe, and accurate data relating to such experience is at the present time very difficult to obtain. My object, therefore, in this paper is to invite your attention to each of the various items of expense in such installations, to obtain information from your experience, and to suggest that it is in the power of the members of the National Electric Light Association to collect such a mass of data concerning the economics of central station operation and the distribution of energy for light and power purposes as will be of the utmost value in judging of the practicability of the thousands of projects of this description which will be under consideration within the next ten years. It is also in the power of this Association to compare, analyze and arrange this information in such a way as to make its application to a new project direct and reasonably conclusive. If there be any means by which failure in ventures of the kind in which you are and will be interested may be avoided, we should certainly put ourselves in possession of those means as early as possible, and I would, therefore, respectfully urge the advisability of concerted action, looking to the collection and proper analysis of information concerning each of the various items of expense, and the various sources of revenue of your central stations. The problem is somewhat complex, and unless we have some definite and progressive method of analysis it is practically impossible for an association which may be considering the subject, or even for a select committee of engineers who may be called upon to advise with reference to a specific case, to arrive at an agreement in which all will concur. I believe, therefore, that we may make good use of the skeleton statement of annual charges.

In calculating the annual charges against the steam and electric plant we must consider the following:

Fb—First cost of real estate and buildings.

Pb—Percentage covering interest upon and maintenance of real estate and buildings.

Cb—Constant expenses, taxes, insurance, etc., on real estate and buildings.

Fs—First cost of complete steam plant, including engines, boilers, steam pipes, pumps, heaters, etc., installed.

Ps—Percentage covering interest upon and maintenance of steam plant.

A—Cost of fuel to produce one pound of steam.

S—Pounds of steam used per indicated horse-power per hour.

N—Number of indicated horse-power hours used per year.

Ws—Cost of water (if any) per annum.

Os—Cost of oil and waste per annum for steam plant.

Fe—Cost of electric generating plant, including exciters, regulators and complete station equipment.

Pe—Percentage covering interest upon and maintenance of electric generating plant.

Oe—Cost of oil and waste per annum for electric plant.

Cse—Constant expenses, including superintendence, wages, taxes, insurance, etc., steam and electric plant.

Then—PbFb + PsFs + ASN + Ws + PeFe + Os + Cse + Oe = annual charges.

For the hydraulic and electric plant we have the following:

Fb—First cost of real estate and buildings.

Pb—Percentage covering interest upon and maintenance of real estate and buildings.

Cb—Constant expenses, taxes, insurance, etc., on real estate and buildings.

Fh—First cost of hydraulic plant, including turbines, dams, flumes, etc.

Ph—Percentage covering interest upon and maintenance of hydraulic plant.

Oh—Cost of oil and waste per annum for hydraulic plant.

Ch—Constant expenses, including superintendence, wages, taxes and insurance on hydraulic plant.

A—Cost of water per horse-power hour (where water rate is paid).

N—Number of horse-power hours at turbine used per year.

Fe—First cost of electric apparatus between turbine and local distributing circuits exclusive of line.

Pe—Percentage covering interest upon and maintenance of electric plant exclusive of line.

Oe—Cost of oil and waste per electric horse-power from generators for electric plant.

Ce—Constant expenses, including superintendence, wages, taxes, insurance, etc., on electric plant.

Fl—First cost of pole line, insulators and conductors.

Pl—Percentage covering interest upon and maintenance of pole line, insulators and conductors.

Cl—Constant line expenses (supervision and repairs).

Then—PbFb + Cb + PhFh + Oh + Ch + AN + PeFe + Oe + Ce + PlFl + Cl = annual charges.

And now, what have we accomplished? We certainly have not arrived at a definite solution of the problem of comparative annual charges, and the more carefully one looks at the statements the more evident does it become that there are many factors the value of which can only be fixed by actual experience. It appears, however, that were we in possession of accurate and detailed data as to the cost, operating expenses and income of a steam and electric plant, we might form a pretty accurate idea of the practicability of an alternative project, involving electric transmission of power. We should also need some information as to the cost of installing and operating hydraulic plants under various conditions; but this can be obtained with sufficient accuracy and with no great difficulty. The evolution of apparatus adapted to the efficient and reliable transmission of energy, and hence to the utilization of vast amounts of power in the form of falling water now wasted, has reached such a stage as makes this question a most vital one, and the importance of information relating to the cost of steam and electric plants now in operation is manifest.

This paper is offered simply in the way of suggestion, and for the purpose of inviting criticism and comparison of opinions. The skeleton statements of annual changes have been hastily prepared, and may doubtless be revised and amended with good results. It is intended simply for classifying purposes, to facilitate the accumulation of much needed data, and to avoid confusion of ideas in discussion of the problem which I have attempted to analyze. I sincerely trust that the suggestion will be taken up by this association, and effective steps taken to increase our fund of observed facts based upon experience, so rendering a most valuable service to engineering science, and prompting the general welfare of all who are interested in the practical use of electricity.

Morals of Corporations.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY E. A. ARMSTRONG.

(*Abstract.*)

A corporation is best defined by saying it is an artificial person, possessing certain limited rights, powers and privileges with a life, varying in each case from a few years to perpetual existence.

That there is a popular distrust, if not actual hatred, of corporations, as such, is undoubtedly true. I have thought more or less upon this subject, and if called on to give my reason for the first origin of this hatred or distrust, I would remind you how they were first created; would ask you to remember the time when the King's Letters Patent, his seal and writing, made the charter; what special powers, privileges, liberties and immunities were given, and for what purpose and upon what consideration; many of them, like ancient titles of nobility, not being able to bear investigation, and then ask if you needed further search.

A corporation of to-day, however, is vastly different from any of these, or indeed of those not half a century old. In most of the States I apprehend their creation is very similar to that of my own State, New Jersey. With us corporations are formed under general laws passed for particular classes. Insurance companies, religious societies, beneficial organizations, hospitals, lyceums, libraries and miscellaneous business corporations, all having their respective acts. A corporation, under any of these acts may be formed for the desired purpose by making and filing articles of association setting forth the prescribed requisites. When this is done, by operation of the law, a corporation is formed. For many purposes only three persons are required. There is no charter, no grant, no executive, legislative or judicial act required. To be sure I speak of the present. Before 1875 it was possible to obtain a special legislative act of incorporation. Now, a corporation being created this way, is it just or reasonable that it be condemned *per se?* I cannot think that it is, because the inherited antipathy is both unjust and unreasonable. It is not, nor can it properly be, a class condemnation even should individual cases merit it.

If in this age and in this presence I should say that this country owes more to corporations than anything else, I don't know how I should be regarded. In some places I know that if I desired to retain as much popularity as any man ought to court, that is, enough to live peaceably beside his neighbor, I would not dare say it. But would it not be true? These same people who in one breath condemn corporations in the other defy co-operation. Crucify the doer and crown the deed. Co-operation has been, and in all probability will be, in all ages the panacea offered for most of the social ills of the time.

If there is to be any great work carried on—charitable, religious or educational—what is the first agency we employ? Association, to be sure, by means of incorporation. We would not think of undertaking it without this agency. It puts the little, insignificant and separately powerless portions into one mighty and effective whole, and by it through concentrated earnest effort, undreamed of results may be obtained. We find it everywhere. Beneficial organizations, life insurance associations, trades unions, all join with one purpose, to get the wisdom, strength and power of aggeration. We are not prone to condemn this, nor should we be.

If, then, so far I am right, the conclusion follows that a corporation is a desirable and a necessary thing to accomplish the greatest good with the least expenditure of energy and wealth. If what I have said does not prove that to your satisfaction, I shall want you, for the sake of my argument, to assume with me it to be proved, for I propose to so consider it. Now, then, comes my application, and I propose to consider it in two aspects. The first are the moral obligations *from* a corporation to the public, first, and then to the individuals composing the public. The second are the moral obligations *to* a corporation from the public, first, and then from individuals, as they can best be considered together. I shall not formally group or place these two headings, but run them right together. Nor do I propose to deal with corporations generally; but, as this is the National Electric Light Association, I propose to consider electric light companies particularly.

The quasi-public character of much of the business of almost every electric light company in its dealings with municipal authority must be emphasized. Every company doing such service occupies such a position of trust as to require it to give a maximum of service at a minimum of cost. Don't misunderstand me. It is not only the privilege of an electric light company to receive, it is its duty to demand fair compensation for what it provides and furnishes. It is just as dishonest for it to take advantage of its position and crowd the municipality as it is the municipality to reverse the tables. We have often taken occasion to complain of the unfair treatment given companies by municipalities, but too often the treatment has been invited. When a corporation such as ours makes a large investment for public lighting, and while it continues to regard what I have indicated as its duty regarding service and charges, it has the right to expect a continuance of the municipal—patronage, I was about to say—service, I will substitute. Any deviation from this, while not a violation of an express, is the violation of an implied contract; something in law just as binding, and, therefore, surely ought to be in morals.

I imagine I might amplify this to a considerable extent, but I will not, further than to say what applies to corporations acting with each other and with individuals, as may hereafter be stated, will all apply, and really with more binding force, upon the relation with the municipal or governing corporation. Such a corporation being a part of the governing machinery, it is bound in law as well as in justice to treat with absolute fairness every person alike. It is dishonest for it to take anything for public use from its citizens at less than cost. When that is accomplished that most undesirable of all things, municipal ownership of electric lighting plants, will be undreamed of and unconsidered. No matter how Utopian may seem the idea of the government doing everything possible, it is the idea most foreign to our notion of government—especially the American idea. Everything possible is to be left to the people, with as little government as possible. A despot could administer the government of this country much more effectively and economically than we do by our cumbersome representative system, pervading every department, as it does, assuming his honesty, good will and ability; but it would prove far from satisfactory, to be sure. We prefer to govern ourselves, although we may not do it so well and it does cost us much more.

Such, briefly, is the way in which our corporations and our governments should regard each other, as I take it. Be mutually regardful of the duties and responsibilities of each other and properly regarding their reciprocal obligations.

That there is to a wonderful extent this appreciation of obligation on the part of the companies is a thing very pleasant to contemplate. If accident or disaster happens to a company, just see what heroic effort is put forth to remedy it. Men and money are never spared. The inquiry is made, Can it be done? And if it be answered affirmatively, immediately comes the decree, Then do it. A notable instance of this, the latest of many coming under my observation, be it said, is that of the Buffalo plant. Our friend and former President Huntley worked with more than his accustomed vim and vigor to make his plant a Phœnix, and did it because his first desire was to serve his city. Say what you will, gentlemen, this is patriotism.

How, then, should corporations regard each other and regard individuals? As I take it, the obligation of the golden rule. It is the duty of our corporation to use the best methods it knows or can learn, adopt all the improvements, and render the best possible service, and that at as reasonable a figure as it can afford to do it, having a just appreciation of the risk the capital invested sustains, which is entitled to an adequate return. If you can furnish light or power at a less figure than you are now receiving, and still pay your stockholders a fair return, it is your bounden duty to voluntarily reduce your prices, so that those who make your business possible may have their share in your prosperity.

Don't try and find the maximum your customer will stand, but find how little you can afford to charge him, and deal with him on that basis. He will soon find it out, and it will pay you better than the other course, if that should be your highest aim. It doesn't pay to make too much money. Understand me, I speak from observation, not experience, for I haven't sinned in that line. Honesty is the best policy, indeed; and by it I mean honesty in its fullest and broadest sense.

So far as I have been able to learn from observation, central station companies of themselves have been very considerate and mindful of each other. The poaching has been at a minimum. To be sure, I exclude from this entirely the *assisted* and *inspired* organizations that masquerade under the name of local companies. This amicable and creditable feeling is, as I take it, largely due to this association and to our electrical papers. The more people know and learn the more tolerant and less bigoted are they.

There is one branch of this subject I have not named, and that is the attitude of the parent and supply companies toward the companies of our association. They, of all people, ought to have regard for us. Indeed, they have in times past had the greatest regard for us; in fact, quite an absorbing regard. Too often, indeed, it has been the fabled regard that the wolf had for little Red Riding Hood.

As corporations we can do what as individuals would be impossible. The aggregation of the littles will accomplish wonders, just as brick after brick makes the tallest and grandest structure. But the beauty and the strength, and, indeed, the utility of the world is absolutely dependent upon the perfection of the single one, the individual. Therefore, fellow stockholders and officers of corporations, in all these things "Be ye perfect."

The Incandescent Lamp from a Commercial Standpoint.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY CALVERT TOWNLEY.

(*Abstract.*)

For convenience in discussion, we may divide the commercial lamp burners into three classes, viz.:

1. The untreated or natural burners used in the Edison lamps.

2. The treated or flashed burners used in the Sawyer-Man, Thomson-Houston, Beacon, and a number of other lamps.

3. What we may call the super-treated burners used in the new Westinghouse stopper lamps.

In all published tests of the life of burners there is shown to be a definite relation existing between the life of a carbon and the temperature at which it is burned, this relation remaining fixed for carbons of the same kind and varying only for carbons of different kinds. If we formulate this relation, it will assist us to determine what temperature of any kind of carbon may be expected to yield the best commercial results; that is to say, how much money it is desirable to spend on the maintenance of the carbon, and how much on the energy to heat it. The temperature of a burner is difficult of measurement. It will, therefore, be simpler, and quite as satisfactory, if we consider the relation between life and energy consumed, expressing the latter in watts.

By a series of experiments, extending over several years and covering tests of many thousand lamps, Mr. Frank Stuart Smith has found the relation between the life and efficiency of the Sawyer-Man carbons, and through his courtesy I am permitted to give you the results. The relation is expressed by the curve *A*, illustrated herewith in Plate I, where the axis of *Y* represents hours life, and the axis of *X*, watts per each candle of light produced. As this relation is confirmed by so many tests made at different times, upon lamps of different efficiencies, and under the care of different assistants, there can be no reasonable doubt as to its correctness. From a limited number of experiments made on many other lamps having treated carbons, it is indicated, as might be expected, that the relation between the lives and efficiencies of their burners follow the same general law. Therefore, if we assume that these lamps are constructed with the same detailed attention to design and manufacture, we may, then, also assume that their curves will not vary materially from that of the Sawyer-Man carbon.

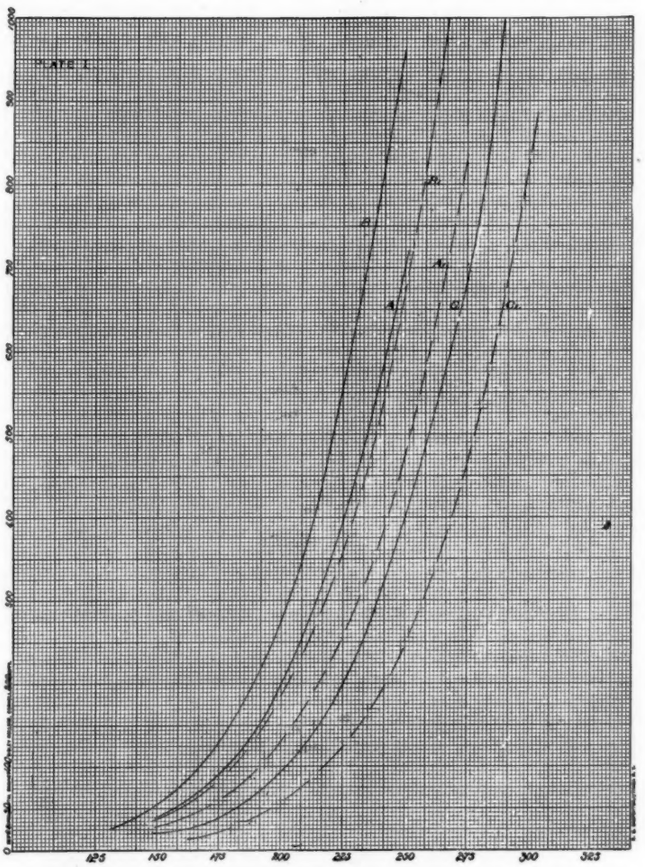

PLATE I.—THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

The exact mathematical expression corresponding to this curve is somewhat complicated, but, as we are considering the question from a purely commercial standpoint, we may consider the curve between commercial limits, in which case we can express the relation within one-half of one per cent. by the formula,

$$L_{,}=3.742\ E_{,}^{5\cdot78} \qquad (1)$$

where *L* represents hours life and *E*, watts per candle.

During the past year a great many tests have been made by Mr. Smith with the super-treated carbons of the Westinghouse stopper lamps, and the relation between life and efficiency thereby found to exist is illustrated by another curve, shown *B*, Plate I. With the same degree of accuracy as above, we may represent this curve between commercial limits by the equation,

$$L_{,}=5.44\ E_{,}^{5\cdot684} \qquad (2)$$

We note that this curve corresponds very closely in its general form to the curve of the treated burners, except that for a given efficiency the life of the super-treated burner is always longer. This is as it should be, inasmuch as the super-treated burner is, in fact, a treated burner which has been subjected to an additional process to render it more stable.

In 1888, Mr. John W. Howell presented a paper before this association, in which he exhibited a curve stated to have been constructed from the results of a large number of tests made with the Edison or untreated burners. I have taken the liberty of reproducing a part of this curve in this paper, shown *C*, Plate I, but using a different scale of measurement. It will be noted that this curve is very similar to the curve of the treated and super-treated burners, and, considered between the same commercial limits, we can express it with equal accuracy by the formula,

$$L_{,,,}=1.052\ E_{,,,}^{6\cdot458} \qquad (3)$$

$L_{,,,}$ and $E_{,,,}$ having the same significance as before. For a given efficiency, we find the corresponding life of any class of carbon by tracing a perpendicular line until it intersects the proper curve, the corresponding life being found directly opposite the point of intersection horizontally. Thus, for an efficiency of 2.5 watts, we find the life of the untreated burner to be 400 hours, of the treated burner, 713 hours, and of the super-treated burner, 962 hours.

It is important to remember that these curves represent the results of laboratory tests, in which the electromotive force is kept more nearly constant than is ordinarily possible under the conditions of central station lighting. Therefore, in order to obtain an expression which will represent commercial conditions, we must introduce the element of a variable electromotive force. In Plate II. I illustrate a curve verified by numerous and exhaustive tests by Mr. Frank Stuart Smith, showing the relation between total energy consumed and the light emitted. This relation is such that a line drawn from any point of the curve to *O* (as *AO*) equals the tangent of the angle made by such line with the axis of *X*. It is represented by the equation,

$$I=\frac{W^2}{\sqrt{R^2-W^2}} \qquad (4)$$

where *I* equals the total illuminating power expressed in candles and *W* equals watts, *R* being a constant, which depends for its value on the size and efficiency of the lamp. *R* is, in fact, the radius of the circle to which our tangent is referred. While the position of this curve varies with different lamps, the relation between the watts consumed and the light emitted remains unchanged through all tests. We know that the resistance of a heated filament will remain practically constant through the comparatively small variations in voltage to which a commercial lamp is subjected. Therefore, if we let *p* equal the per cent. variation in electromotive force, we may write from our fundamental electrical equation $(1+p)C=(1+p)\frac{e}{r}$, whence

$$W_{,}=W(1+p)^2$$

By a combination of this equation with formula (4), we get the expression

$$\left(\text{since}\ \frac{W}{I}=E\right)$$

$$E_{,}=\frac{\sqrt{E^2+1-(1+p)^4}}{(1+p)^2}$$

where *p* equals per cent. variation in electromotive force, due to commercial conditions. Substituting this value of *E*, therefore, in equation (1), we get the expression for the commercial curve of the treated filament,

$$L_{,}=3.742\ \frac{[E_{,}^2+1-(1+p)^4]^{2\cdot865}}{(1+p)^{11\cdot46}}$$

By substituting the same valve in equation (2), we get the expression for the commercial curve of the super-treated filament

Crocker-Wheeler Electric Company's New Factory.

The Crocker-Wheeler Electric Company, New York city, has bought the large plant of the Spiral Weld Tube Company at Newark, N. J., and are preparing to move in. A feature of the new factory will be the conspicuous absence of belting and shafting throughout the entire works. The plan to be adopted is to transmit the power to each machine by wires, which will connect with a motor on the machine and drive it direct. This method will be followed in the case of every machine where it is found possible, and will result in a considerable saving of power which would be otherwise required to constantly run lines of shafting and counter-shafts to each machine, as well as a large saving in the cost and maintenance of belts, counter-shafts, pulleys, oiling, etc. It is expected that the new establishment will give employment to 1,000 hands, many of whom will go to Newark with the company.

Overheard at Albany.

MRS. SCHODACK (as the trolley car passes)—Goodness, pa! What makes that 'ere car go?

MR. SCHODACK—I don't know, 'Mandy; but I guess it's them wire-pullers we read about.—*New York Truth.*

$$L_{,,}=5.44\frac{[E_{,,}^{2}+1-(1+p)^{4}]^{2\cdot842}}{(1+p)^{11\cdot365}}$$

Again, by substituting in equation (3), we get the expression for the commercial curve of the untreated filament,

$$L_{,,,}=1.052\frac{[E_{,,,}^{2}+1-(1+p)^{4}]^{2\cdot226}}{(1+p)^{12\cdot906}}$$

It is, of course, impossible within the limits of this paper to attempt to express all conditions; but by a comparison of laboratory and central station records a fair average assumption seems to be that, with proper attention to regulation, the commercial variation is equivalent to a constant excess voltage of three per cent. I have taken this as a basis, and constructed commercial curves for the treated, the super-treated and untreated filaments, which are shown as dotted lines in plate I, and designated as *A*, *B* and *C*, respectively. It now becomes possible to calculate accurately the efficiency at which any class of lamps should be burned in order that they may yield the best economy.

It is important to note the great effect that a comparatively small rise in electromotive force has on the life of a lamp. Any neglect to maintain the best possible regulation, therefore, will result in an increased bill for lamp renewals entirely out of proportion to the variation in voltage itself.

The condition of the incandescent lighting business throughout the country is undeniably prosperous. Everywhere central station companies are wiring additional lights or preparing to increase the capacity of their machinery. We will not be far wrong, therefore, if we assume, in the consideration of our subject, that the central station company has a market for all the lamp hours it can furnish during a certain portion of the day's run. With this assumption, let us formulate an expression for the profit in incandescent lighting, then we may determine what conditions will give this profit a maximum value. In the consideration of this matter I have taken as the unit of value one 16 candle lamp hour, assuming that what the public want is light, and that, other things being equal, they do not care whether much or little energy be expended to produce it. Therefore, whenever we can increase the efficiency of our lamp, we not only reduce the cost of the energy required to burn it, but also increase the lamp capacity of our station, lines, converters, etc., by a proportional amount. Owing to the fact that the various meters in use measure, not light, but energy in one form or another, when we make our unit the lamp hour and afterwards increase the efficiency of our lamp, we must also increase our charge per unit of energy in order to maintain the same standard of price. Were any unit of energy to be taken as the unit of value, the receipts from a given output would become fixed, and the best lamp at once the most inefficient and longest lived. Political economy is clear, however, that to reduce the price of any commodity increases the demand for it, and in competition with other illuminants the only proper standard can be that of illuminating power. It is nearly always possible to change existing rates whenever it is proper to do so.

With our unit of value illuminating power, therefore, our profit will obviously be the difference between the cost and selling price of a lamp hour multiplied by the number of lamp hours sold. We may, therefore, write the expression—

$$P=(v-c)\frac{S}{W}$$

where P equals profit, V selling price, c cost of lamp hour, S output of station in watt hours for the time for which our profit is estimated, and W watts required per lamp. Again, the cost of producing one lamp hour is clearly the proportionate cost of the lamp itself plus the cost of the energy consumed by it. We may, therefore, write—

$$c=\frac{1}{L}+\frac{g}{1000}W$$

where 1 equals cost of a lamp in cents, L its life in hours, and g cost of producing one kilowatt hour of energy. Substituting in this expression, from the formula of our commercial curves, the value of lamp life in terms of efficiency (bearing in mind that for a 16 candle-power lamp $E=\frac{W}{16}$), and putting our expression for the value of c in place of c in the formula representing our profit, we have the equation—

$$P=\frac{VS}{W}-\frac{S1(1+p)^{2b}}{Wa\left[\frac{W^{2}+256-256(1+p)^{4}}{256}\right]^{\frac{b}{a}}}-\frac{Sg}{1000}$$

where a and b stand, respectively, for the co-efficients and exponents of the second terms, formula (1), (2) and (3).

	A	B	C	D	E	F	G	H	K
v	.005			.0075			.01		
g	5	3	2	5	3	2	8	6	2

Curves similarly lettered are constructed with similar values of g and v, the differences in their position and form being caused partially by the different costs of the lamps and partially by the differing relations between the lives and efficiencies of the several classes of carbons.

I illustrate in Plate III a number of curves constructed for the untreated, the treated and the super-treated filaments, using this formula. I have taken the original cost of the lamps at, respectively, 35, 50 and 20 cents, the selling price of a lamp hour at, respectively, .5, .75 and 1 cent, and the cost of producing a current at, respectively, 2, 3, 5 and 8 cents per kilowatt hour. By the courtesy of a considerable number of central station managers, who have furnished data concerning their respective plants, the average cost of this energy appears to vary between 3 and 7 cents. The only cases where 7 cents is exceeded are those in which fuel is a very expensive

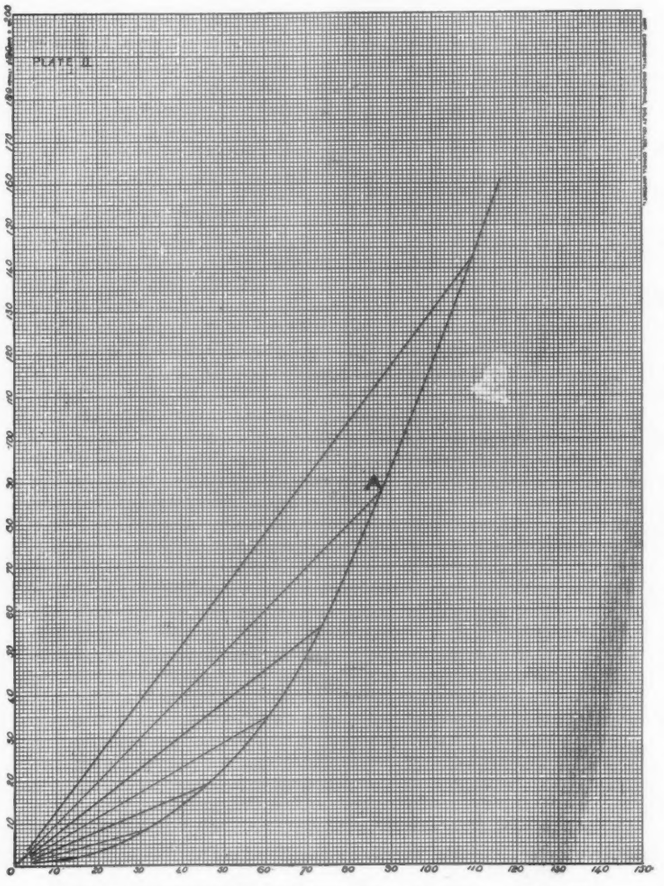

PLATE II.—THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

commodity and the station output is small. Where 3 cents is too high a very cheap fuel is used and a very large station operated. In assuming these values, I believe that we have covered as nearly as possible the conditions which actually exist, but it is quite easy to adapt our expression to any set of local conditions.

In Plate III, you will note that the (Y) axis represents cents and the (X) axis watts per lamp; the station output estimated upon being the unit of one kilowatt hour. The highest points of our several curves represent the conditions under which our profits are a maximum, and the vertical distances between these highest points and any other points on the same curves show the loss in profit due to the use of a lamp of other efficiency than the most economical. The vertical distances between the highest point of any curve of one class of lamp and the highest point of a corresponding curve of another class of lamp show the profit or loss resulting from the use of different classes of lamps at their respective best efficiencies. Other combinations will be readily noted by observation. For example, with the price of a lamp hour at one cent, and the cost of generating current six cents per kilowatt hour, the best result we may expect from the treated filament lamp at 50 cents each is, with a 38 watt lamp, *i. e.*, 2.37 watts per candle, when our profit should be (see curve H) 16.6 cents per kilowatt hour. With the super-treated lamp at 20 cents, other conditions remaining the same, the best results are obtained with a 30 watt lamp and our profit should be (see curve H) 22 cents per kilowatt hour.

Considering all these curves together, two facts are especially prominent, namely: first, that although we have assumed strictly commercial conditions, the profits obtained are in excess of those actually made in practice, and, second, that the most economical lamp efficiencies are considerably higher than those of any commercial lamps now in use. It is interesting and very remarkable to note that in every case the profits fall off very rapidly for lamps of either too low or too high efficiency, the variation being more marked where current is dear and running expenses high. By putting these facts together, it is apparently clear that the long lived inefficient lamp is a very expensive article, and that too much weight has been given to the cost of lamp renewals, which shows prominently on the expense side of our ledger, while we have not paid enough attention to the great waste of energy due to low lamp efficiency. By a reference to Plate I, we note that the most economical conditions call for, in the case of the untreated filaments, a life of between 250 and 535 hours; in the case of the treated filaments, a life of between 286 and 620 hours, and in the case of the super-treated filaments, a life of between 138 and 260 hours; the shorter life being in each case where both the cost and selling price of the lamp hour is high. I submit these figures for your consideration.

You will note from Plate III, that with a charge of three-quarters of a cent per lamp hour and five cents for the expense of generating one kilowatt hour, the use of a 50 watt lamp loses the operating company 1.05 cents for every kilowatt hour sold when using the 35 cent lamp with the untreated burner; 1.4 cents when using the 50 cent lamp with the treated burner, and 5.3 cents when using the 20 cent lamp with the super-treated burner, as compared with the profits which might be made if these various lamps were used at their respective best efficiencies.

It is gratfying to find that the possibility of increased profits carries with it the implied possibility of reduced prices to the public and, therefore, a great demand for light, and greater success to the companies furnishing same, in competition with other illuminants.

I have said nothing in this paper in regard to fall in candle power, for the reason that, in both the treated and super-treated filaments, this fall is roughly proportional to the time the lamp has been burning, as compared to its total life; that is to say, if a filament has a life of 1,000 hours at a given efficiency, and during that time its fall in candle power is A per cent., if this filament is burned at an efficiency which will make its life 500 hours, its fall in candle power will still be approximately A per cent., so that our commercial results are not appreciably affected. For the untreated filament the fall in candle power is proportionately larger than in the other two filaments. Therefore, if we are making a comparison of total illuminating power per energy consumed, we must put the untreated filament on a somewhat lower scale than shown in the comparisons I have drawn.

The "Vulcanizing" Process for Preserving and Strengthening Poles, Cross Arms, Ties, Etc.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY HARRY C. MYERS, PH. D., F. C. S., ETC.

(*Abstract.*)

Hundreds of processes for preserving wood have been patented, and all of them may be divided into two classes: 1. Those in which wood is impregnated with a preservative material by immersion. 2. Those in which a preservative agent is forced into the pores of the wood. Such chemicals as copper sulphate, zinc chloride, mercuric chloride, dead oil, etc., have been applied, but experience and results have failed to prove them all that is to be desired in an economic and effective means of wood preserving. The poisonous nature of such chemicals makes the application and use of them very objectionable.

In the process of "vulcanizing," wood is heated in closed cylinders from 8 to 12 hours, at a temperature ranging from 300 degrees to 500 degrees Fahrenheit and under a pressure of from 150 to 200 pounds to the square inch. A circulation of superheated and dried compressed air removes the surface moisture and any water that does not take part in the reaction and combine with the woody constituents. Hence, wood or timber, in any condition, may be immediately treated. These cylinders for the treatment are 105 feet long, 6½ feet in diameter, and are made of steel. As the treatment penetrates to the heart of the timber, considerable time is required for cooling, which is, of course, done in the cylinder and under pressure. Timber is introduced and treated upon cars which run into the cylinder upon small tracks. The percentage of dark antiseptic matter contained in *vulcanized* woods I find to be as follows:

Vulcanized yellow pine	55.3 per cent.
Vulcanized Norway pine	56.7 per cent.
Vulcanized Virginia pine	58.9 per cent.
Vulcanized red oak	54.0 per cent.
Vulcanized spruce	57.9 per cent.
Vulcanized white pine	55.5 per cent.
Vulcanized poplar	59.0 per cent.
Vulcanized cypress	56.8 per cent.

The samples from which these results were obtained were companion pieces to those from which the previous results were obtained; a comparison shows the percentage of moisture removed by the vulcanizing process.

This process, apparently, makes decay impossible by sealing up the pores of the wood with antiseptic matter, which becomes solid and firm on cooling and standing, and which is produced *within* the wood by the action of heat and pressure upon its original sap.

The original sap is colorless or pale yellow, and the changed sap very dark or black, hence, a most desirable dark, antique color may be imparted to oak and other woods.

The following tests were made at the School of Mines, Columbia College, by request of the Western Union Telegraph Company, upon cross arms to be used on telegraph poles.

In each case two cross arms were made from the same piece of timber, one was vulcanized and the other left untreated. Results give, in pounds, the weight required to break each cross arm:

Vulcanized Norway pine	3,000 pounds.
Natural Norway pine	2,680 pounds.
Vulcanized cypress	2,600 pounds.
Natural cypress	1,860 pounds.
Vulcanized spruce	2,780 pounds.
Natural spruce	2,460 pounds.
Vulcanized poplar	2,840 pounds.
Natural poplar	2,560 pounds.

These startling results show an average *increase* in strength of 18.9 per cent. Similar tests made by Prof. R. H. Thurston and Prof. Alfred Trautwein, of Stevens Institute, verify the above results.

The Hon. B. F. Tracy, Secretary of the United States Navy, with a view of adopting vulcanized wood in naval construction, appointed a committee who visited the vulcanizing works in New York city, made tests of their own on yellow pine, showing an average increase in strength of 18 per cent. and a decrease in deflection of over 13 per cent.; hence they reported that vulcan-

izing increases the durability and strength of timber, and recommended such timber for use as backing in one of the monitors.

Untreated cross arms which had been painted and used by the Bell Telephone Company for from two to three years showed by actual test an average *decrease* in strength by exposure of 18.78 per cent., as compared to new untreated cross arms. Other pine cross arms which had been in service on Western Union telegraph poles for three years and over showed an average loss in strength by exposure of 38.12 per cent. The process of vulcanizing seasons all timber, thoroughly preventing any further warping, checking or cracking. Such timber is not influenced by atmospheric agencies, bacteria or spores, and requires no paint for protection, as it is saturated with antiseptic preserving material of its own; the albuminous constituents of the natural wood have been coagulated by the high heating and rendered insoluble. Loblolly pine, as it is used in the South, decays in about three years, and is unfit for any railroad construction where it is exposed to the elements.

This timber when vulcanized is as durable as ordinary timber and ties used in railway construction. Other woods are seasoned and rendered beautiful by vulcanizing, which produces very desirable colors for interior decoration.

The life of vulcanized timber is not known; none of the timber or ties used in railway construction during the past ten years have been known to decay. I personally examined some 12x12 pine timber which had been placed in a machine shop in 1882, part being vulcanized and part untreated. The treated timber is perfectly sound and still in use, while the untreated had completely rotted and crumbled away after five years' use. I also find by personal investigation that timber placed on the Manhattan Elevated Roads, of New York city, as far back as 1883, shows no signs of decay, and is as sound and sweet as if fresh from the tree, while untreated timber laid at the same time has rotted away and been replaced.

As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added by vulcanizing, the wood being rendered more cohesive, harder and denser. The spike holding quality is naturally much increased, and even after ten years' service railroad spikes seem to be as firmly embedded as when just driven.

It is also a curious fact that the electrical resistance of most woods is very greatly increased by vulcanizing.

A new power house and car barn is to be erected by the Chicago North Shore Street Railroad Company at Edgewater. It will adjoin the electric lighting station on Evanston avenue, west of the Chicago and Evanston tracks. It will be one story high, 100 by 200 feet in dimensions, and built of pressed brick, with stone and terra-cotta trimmings. It will cost $30,000.

Underground Conduits and Conductors, and the Experiences of Electric Lighting Companies of New York City.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., BY WM. H. BROWNE.

Those who are intimately acquainted with the histories of the electric lighting companies of New York city may be pardoned if they believe that the experiences undergone by these companies have been unique, and that they afford to companies elsewhere opportunities for beneficial consideration.

At the risk of presenting some incidents having the aroma of antiquity, or being tedious by the recital of what may, perhaps, now be considered well-worn tales, attention is invited to a statement as brief as possible of the story of electric lighting in New York city from the beginning to the present time.

In the years 1880 and 1881, but 12 or 13 years ago, two companies began in New York city the business of distributing electric current from central stations for public and private illumination, the one using the Brush, the other the United States system of arc lighting.

They were the pioneers, at least in that city, in the business of electric lighting. They were provided with apparatus which, compared with present standards, would be considered totally inadequate to the designed purpose. They were obliged to undertake the operation of such apparatus with employés who were necessarily ignorant of its construction and methods of use. They had also to encounter an atmosphere of mystery in which the electrical business seemed to be enveloped, and which was intensified by the pernicious ideas of those who had learned, or believed they had attained some knowledge of it, that their personal advantage and preferment was obtainable only by secluding to themselves such information as they believed they had acquired. In brief, these companies experienced to the utmost all the trials and difficulties belonging to those who begin in new and untried fields.

Coincident with this imperfect apparatus and the other difficulties alluded to, the best medium then obtainable for the transmission of current of high potential was bare wire.

Contrast that means of transmission with what is now deemed requisite.

The first step from that bare wire towards the underground conductors of to-day was soon found necessary.

That necessity developed the cotton covered wire, and with that the operatives felt safe from injury by shock.

Soon some protection from the conveyance of fire by the covering became necessary, and then followed the saturation of the cotton covering with lead. This proved so equal to the conditions that the Fire Underwriters in the interest of insurance companies formulated rules prohibiting the use of any other but that wire, which obtained their own name of "Underwriters."

With this progress in the improvement of the conductor, improvements in the apparatus and appliances brought them to such a condition, that coupled with the knowledge acquired by the operatives in the handling of them, and the most scrupulous supervisory control of the lines, it became possible to pass through one entire night occasionally without having lights out, or a "dead ground," or "short circuits," and that was a night to be inscribed upon the archives of the companies as an occasion from which to date progress toward the next improvement.

It will, no doubt, seem to many of you who have not had personal acquaintance with similar conditions, incredible that capital could have been invested and efforts exploited in a business conditioned as this was in those days; but the above statements are merely the baldest facts, and could be amplified by numerous incidents in testimony of their strict accuracy.

However, the companies struggled with the conditions; they sought and used all the improvements obtainable and finally were able to give tolerably consecutive service, with the result that a few customers began to use the light and were willing to pay a fair price for it, 75 cents to $1.00 per light per night.

But the extension of the use of electric illumination was not so rapid or so widespread as to call for many wires or very large poles. The operators of the company had not had such strong pecuniary inducements as to justify them in being very enthusiastic in looking to the possibilities of the future.

They felt justified in restricting their efforts to satisfy such demands as were made upon them, and whenever a customer was obtained beyond the limits of the wires already erected the lines were extended with the least possible expense.

The poles used were ordinarily 6 to 8 inches in diameter at the base, and 20 to 25 feet high, provided usually with a four-pin cross-arm. A few of these poles have remained and are in existence at the present day.

In the year 1884 manufacturers of other apparatus saw in New York city a field of profit and advancement for their machinery. New York was the largest and richest city of the United States; the companies then doing business in that city were actually on the verge of paying dividends; and it could not be considered proper in the interests of the public that they should continue to have a monopoly; investors were sought and assistance obtained toward the creation of other companies who would utilize their apparatus and reap great profit in the furnishing of electric light to the citizens of that great city. The result was that in the year 1884 franchises were granted to no less than six other companies, all of them primarily intended for arc lighting. Some of these companies, taking note of the numerous poles that were in existence for the telegraph, telephone, police and fire department service, deemed it uneconomical to erect poles for their own wires, but arranged with those having charge of such poles for the attachment of the electric light conductors on those existing poles. Some of the companies created in that year did not make rapid progress, and the increase of poles and wires for electric lighting was not materially appreciable until 1888.

During those years, however, the wires for telegraph, telephone, messenger service, police and fire alarm had increased rapidly and become so numerous and filled the air with so many strings of iron, that the public became offended, and bills were introduced in the State legislature looking to the burial of those wires. The electric light wires were so few as to be scarcely noticeable and did not attract attention.

In 1884 a bill was passed in the legislature directing that the wires be removed from the streets before the first day of November, 1885, but it provided no means to insure their removal, nor penalties for non-removal. The legislature of 1885 having found that the previous enactment had accomplished nothing, passed another act which provided "that if no suitable plan should be proposed for placing the said wires underground, it should be the duty of the said Board of Commissioners to be caused to be devised and made ready for use, such a general plan as would meet the requirements of the said Acts of 1884-5, and that the said board should have full authority to compel all companies to use the subways prepared." Under this act the Subway Commissioners who had not been provided by the act with funds wherewith to carry out the object named in the act, deemed it wise, in order to carry out the purpose of the enactment, to make a contract with some company to build the subways, and did make such contract in 1886.

Persons interested in the telephone company realized that the purpose of the act would inevitably be carried out; and as the interest of that company in the fulfillment of such purpose would be affected to a greater extent than any other, except possibly the telegraph company, they deemed it prudent to become interested in the company with whom the Subway Commissioners had made the contract for the construction of subways. This secured to the telephone company a right of way of almost incalculable value. Even at that time the place and method of the burial of electric light wires was scarcely considered. Some approaches were made to the two old companies engaged in electric lighting, as to their taking upon themselves the task of building subways for electric lighting purposes, but they, it appears, chose to refuse to entertain the proposition. If they had decided, as did the telephone company, it is very probable a different condition would now exist in the electric lighting business in New York city.

In 1888 began the introduction of the alternating system of incandescent lighting. Until that year electric lighting had been confined almost exclusively (of course, outside of the low tension company) to arc lighting; and the increase in the business to that time had not required the multiplication of wires and poles to any considerable extent. In 1888, however, four companies began a spirited effort for the introduction of incandescent lighting, with the result of contracting for upwards of 60,000 lights within less than a year. This caused a considerable increase of wires. The wires were strung principally upon the poles previously in use Comparatively few new poles were erected until, in the latter part of 1888, the Board of Electrical Control, recognizing the increase of electric lighting, formulated rules for the extension of that business by means of overhead construction, and in order to provide the best possible overhead construction, prescribed certain requirements on which, with the immediate supervision of the Board of Electrical Control, what has probably been the finest line in the world was erected. It was considered an ideal line. It consisted of poles 85 feet high, 16 to 20 inches in diameter at the base and not less than eight inches at the top. On this line were strung something like 150 wires, none less than No. 4—the majority No. 2. The poles were made tall so that the wires might not interfere with the operations of the fire department; and if breaks should occur between poles the wire could not reach pedestrians, and also to avoid the numerous crosses with the other wires, which were the source of much trouble. To further secure these results the cross-arms were placed at the highest part of the poles. Experience soon suggested that this mass of weight must be removed from the top, and they were carried down some 15 to 20 feet. This precaution was, however, not sufficient as, in December, 1891, a section of that line, about a mile in length, fell into the street.

During 1888 the companies having aerial lines in upper Broadway, the principal thoroughfare of the city, were directed to place cables in the conduits which had been prepared in that street and to remove their overhead construction.

But the companies objected strenuously. They declared vigorously that it would be impossible to operate currents of high tension underground.

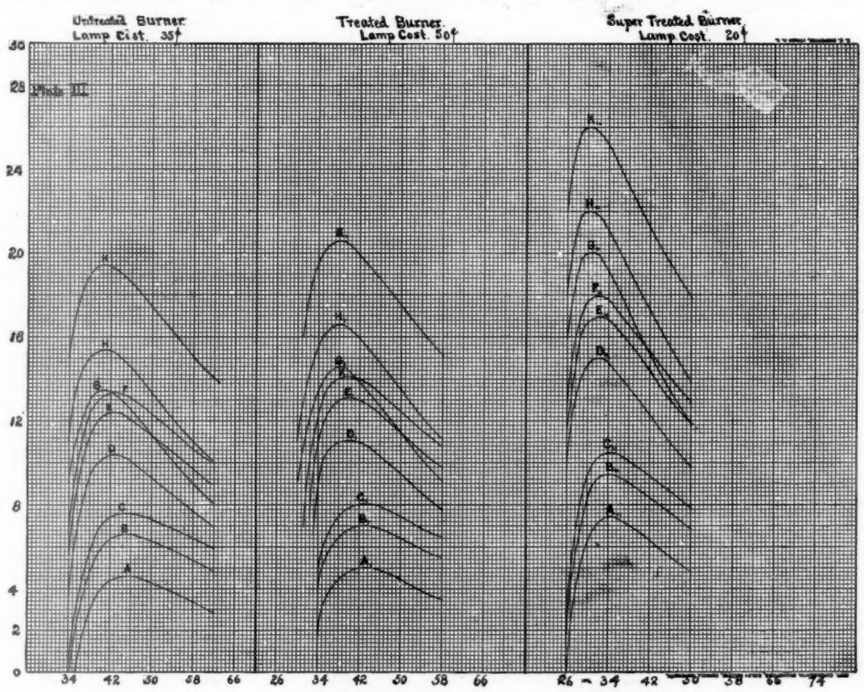

PLATE III.—THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.

They were supported in this contention by professors and others learned in the art.

They appealed to the court to be sustained in this position.

The then Mayor of the city, also, by virtue of his office, President of the Board of Electrical Control, agreed substantially with the companies and opposed his fellow members.

The controversy became heated and to a great extent personal. In fact so much so that the Mayor refused to sit with the other members of the Board of Electrical Control.

The Courts declared that the law gave to the Board of Electrical Control the power and the right to decide whether the subways were fit and proper for the purpose, and ruled that the companies must comply with the law and occupy their subways with their cables and remove their overhead construction.

In August, 1888, the first effort was made to use the electric light subways on Broadway from 14th to 35th streets. The Subway Company had invited the companies to make the experiment of operating high tension current underground, and offered the use of the subways without rental for the experiment. The first cable was placed for arc service and consisted of eight conductors, insulated from each other and enclosed in lead armor. The experiment with this was not successful. The cable did not meet the requirement of the Board of Electrical Control of an insulation resistance of fifteen megohms per mile for each 100 volts for each conductor. This result seemed to verify the claims of the companies that arc lights could not be served from underground conductors under the conditions imposed and existing.

The opposite view was maintained, however, by the Board of Electrical Control, and its contractor company, and the courts having held that the law accepted no other decision than the opinion of the Board, the companies were threatened with the removal of their aerial wires in the localities provided with subways whether they placed cables in the conduits or not.

The year of 1890 brought a new mayor and president of the Board of Electrical Control. He immediately promulgated the order that within 90 days the wires must be removed by the companies from streets provided with subways or he would exercise the right given by the law to have them removed by the city.

At that time two other companies undertook to make a test, one to the extent of one block on 125th street, the other of a circuit of 21 blocks on Broadway and Sixth avenue for ten arc lights.

Controversies and contentions between the companies and the authorities had become so animated that the companies were not credited by the authorities with being disposed to have the experiment succeed, and although they laid their cables with all attainable speed, and were successful in the tests and announced their intention to occupy the subways as rapidly as they could, no extension of the 90 days' time was granted, but on the 5th day of April, 1889, the authorities began the cutting down of the electric light aeriel lines on Broadway and Sixth avenue, where the subways had been provided.

This action aroused great excitement in the public mind, and the authorities were applauded by the newspapers for their vigor. The occurrence of several accidents, principally to employés working on overhead lines, added opportunity for furtherance, by sensational articles in the newspapers, of the excitement, so that the Board of Electrical Control, who in the preceding year had devised the rules under which the large line heretofore referred to was erected, and who had supervised its construction and believed that by it they had found a way to provide for the extension of electric lighting and carry out the provisions of the law under which they were established, without excessive construction of subways, objected wholly to the use of aeriel lines for electric lighting purposes, with the result that in October, 1889, they declared destruction practically to all the lines in the city, except the one built under their guidance the year before and ordered the construction of subways with what can now be undoubtedly considered erroneous judgment and with undue precipitation.

Concert of action between the authorities and the companies, careful deliberation of the probable requirements and the energy which makes haste slowly but correctly would not have produced, it is true, the removal of the overhead lines to the extent that was accomplished within practically two years; but also it would not have produced the extraordinary expenditure of money both by the Subway Company and the electric lighting companies, nor the loss of business and disturbance that occurred to the companies; but it is fair to presume that a somewhat different condition of the subway situation and of the electric light companies would have been effected with material benefits to all financially interested.

There have been built for high tension electric lighting 600 miles of ducts; of this about 260 miles, or 42 per cent., are rented by the companies. Included in the amount stated as rented by the companies are about 50 miles not occupied yet with cables. These ducts so rented and not occupied are the result of a rule passed by the Board of Electrical Control in 1890, in deference to the wish of the Department of Public Works, that wherever streets were to be repaved, subways must be built previous to the paving, or they would not thereafter be allowed, and companies failing to make application for conduits in such streets at that time would be deprived forever after of the opportunity of obtaining accommodations in those streets for the transaction of their business. They were further required, in making application for such accommodation, to give a bond securing the occupancy of and payment of rental for such ducts as were so constructed for five years from the date of completion. This rule was subsequently enacted into a law by the Legislature. Under that rule the companies applied for the construction of subways in anticipation of the future, and not for immediate need.

At the present time there are, therefore, occupied with cables only about one-third of the ducts built. Instances of subways built in excess of requirements as developed to the present date may be noted. On Broadway there are 200 miles of ducts, of which but 80 miles are occupied; on Third avenue 142 miles, but 41 miles occupied; on Twenty-third street 34 miles built, 11 miles occupied; on Twenty-ninth street 28 miles built, 17 miles occupied. It may be considered a very reasonable calculation that the increase in the occupation of subways on these streets will never require all the ducts built.

The 600 miles of ducts occupy only 78 miles of streets. The number of miles of ducts, therefore, in any street occupied with cables averages less than three miles. With the 600 miles of ducts now built distributed in this ratio, nearly 200 miles of streets would be provided with subway accommodation, and the extent of the territory available for the development of the business enlarged to three times its present area. Of the 600 miles of ducts, 454 miles were built prior to the year 1890, and included in that construction were the streets above recited, in which continue to be so large a number still unoccupied.

During the last year, 1892, 24 miles of ducts were built, occupying nearly 10½ miles of streets, or an average of two ducts per street.

If the work could be begun now in the light of present experience, the average number of ducts per mile of street would not probably exceed three. For all kinds of service, one duct will provide ample accommodation in the greater portion of the city.

The 200 miles of ducts occupied with cables are confined to the 78 miles of streets, and contain for main cables about 600 miles, or nearly eight miles of cable per mile of street, and an average of three cable per mile of duct occupied. About 320 miles are used for arc circuits and 280 miles for incandescent circuits.

These cables represent in many instances the occupation of a given street of ducts by each of four separate groups of companies, all seeking business and having customers in the same street and often in the same block.

But for this quadruplication of occupancy, the mileage of cables at present in use would provide current in a much greater mileage of streets, and to a larger number of customers.

The cables are divided into 81 circuits for arc lighting and 50 circuits for incandescent lighting, all the latter being used for the alternating system. One of the arc circuits is about 15 miles in length, several are about 12 miles long, 18 are longer than 8 miles each, and 40 over 5 miles; the average, however, being less than 4 miles. The incandescent circuits average over 5½ miles each.

Connecting these main lines with the premises of customers through the subsidiary subway connections are about 150 miles of cables, so that the aggregate mileage of cables underground is about 750.

The 81 arc light circuits supply about 5,000 arc lights, or an average of about 60 lights per circuit, and an average of about 15 arc lights per mile of cable.

The incandescent circuits supply about 90,000 incandescent lights, or an average of about 1,800 lights per circuit, or about 320 lights per mile of cable.

In the operation of these 750 miles of cable there have been manifested during 1892 faults of all kinds to the number of 49. Faults are reported to the subway company as soon as discovered. As access to the ducts cannot be had except under the supervision of the employés of the Subway Company, it must be assumed that all faults discovered are reported. Faults are classified under three heads: "Low tests," "Grounds," and "Burn-outs."

"Low tests" are discovered in the tests which are required weekly of every circuit, and mean that the insulation resistance of the cables has fallen below the minimum of 5 megohms per 100 volts per mile, below which it is not permitted to operate a circuit until the fault has been ascertained and remedied. The number of "low tests" for the year were five on arc and six on incandescent circuits. The "low tests" were discovered to be in the terminals, one being on an arc, the other on an incandescent circuit. The cause of three "low tests," one on an arc and two on incandescent circuits, was not ascertained. Three "low tests" on arc and three on incandescent circuits were discovered to be due to bad joints.

"Grounds" were discovered 16 times on arc and eight times on incandescent circuits; eight of the grounds on arc and one on incandescent circuits were discovered to be in the terminals. The cause of three "grounds" on arc and one on incandescent circuits is unknown. Two "grounds," each on arc and incandescent circuits were ascertained to be due to mechanical injury to the cables, and three "grounds" on arc and four on incandescent circuits were discovered to be due to bad joints.

Eleven "burn-outs" occurred on arc and, three on incandescent circuits; three of the "burn-outs" on arc circuits were due to causes not ascertained. Three "burn-outs" on arc and three on incandescent circuits were ascertained to be due to mechanical injury of the cables and four "burn-outs" on arc circuits were ascertained to be due to bad joints.

Two "low tests" and nine "grounds," due to terminals cannot be considered as faults in the cables proper. Of the 38 faults discovered in the cables, 18 were due to bad joints, 10 to mechanical injuries, and 10 to causes unknown; but probably mechanical injury.

The 38 faults of the cables occurred on 25 circuits, so that 106 circuits were operated throughout the entire year without a fault or trouble of any kind. Two of the 25 circuits were each responsible for five of the faults, one having four "burn-outs" and one "ground," the other four "grounds" and one "low test."

It may be said here that the troubles from bad joints occurred usually at the beginning of the use of the circuit, and the same may be said to a large extent of the troubles with the terminals. This can be avoided by careful work.

The nine "burn-outs," eight "grounds" and three "low tests," due to mechanical injuries or causes unascertained may be considered as the dangers which cannot be guarded against in a system where cables of several companies are in the same manhole, to which employés of each have access, but the experience of nearly four years indicates that this source of trouble is decreasing. From May, 1887, to March, 1889, twelve explosions occurred in the subways; since the latter date none has occurred. No one has been injured from any cause.

Most, if not all, the incandescent circuits are operated every hour of the day, and some of the arc circuits also. Tests are usually made with all connections undisturbed.

Customers, for incandescent lighting especially, have come to expect the light to be ready for them whenever they call upon it, and to be uninterrupted and of high standard. The above record of faults or troubles with the cables indicates that they may rely upon such service, and the occupation of the member of the staff of an electric lighting station known as "trouble hunter" has passed away.

Nearly all the current for the high tension arc and incandescent service transmitted in the city of New York below the Harlem River is conveyed by underground cables. Above the Harlem River the Board of Electrical Control allows the construction of aerial lines, no subways having been built in that section of the city. Below the Harlem River no overhead wires are permitted to be erected, and few of those that were in existence remain. It is probable that before the end of this year scarcely any will be in existence. The penalties endured by the companies for their opposition to the subways have been severe and drastic. The expense imposed upon them in their effort to take care of their business and meet the requirements of transferring their systems from overhead to underground has been enormous and burdensome. The expense continuing for rentals, due in a large measure to the amount of subways constructed and not occupied, continues, and seems likely to continue to be an enormous tax. These expenses and burdens have tended, and are likely to tend further in the near future, to confine the operations of the companies to territory contiguous to their generating stations, and may also tend to avoid the fierce competition which existed during the days of aerial transmission, and which lowered price to a point below remunerative rates.

If the subway situation in New York city was not such as it is, and it is such from the causes above suggested, there seems no reason to doubt, in the light of the experience possessed by all conversant with the situation, that fully as satisfactory accommodations and results could be accomplished at not exceeding 25 per cent. of what it has cost, and with corresponding beneficial conditions, which would prove, at least, not unremunerative to all interests affected.

From the experiences of electric lighting companies of New York city in their early days to that of their present practically uninterrupted service is a vast step in advancement in operation. The business of the generation and transmission of electric currents for all purposes to which it is applicable is no longer in the tentative condition of these early days. There is no longer any reason for beginning a company without full conception of what it may be expected to do. Competent engineers and electricians are many, who know the exact relations necessary between the several parts of a central station and its output. They are competent to plan the exact conditions needed between the boilers, engines, generators and conductors. With the use of electricity for power for street cars and mechanical requirements conductors will be multiplied.

May it not be concluded, in view of the experiences in New York city, that all aerial conductors are necessarily transitory, particularly in our large cities?

Is it not advisable for controllers and managers of companies in such places to recognize that condition and endeavor to avoid the experiences of New York companies by planning deliberately the procurement of the right to themselves to build and operate their own subways and further to utilize the experiences of New York to avoid the expensive mistakes there made, and to place their business on a stable footing and in a position where they may have immunity from injurious and cheap competition and secure service to their customers free from the interruption belonging to aerial transmission? It is rumored that one company in a large city, where no laws compel them to do their business underground, feel themselves forced to seek that method of doing their business, by reason of the fact that their aerial lines are being overloaded. Is this not likely to be the case in many other places? The telephone companies find it materially to their advantage to use underground conductors, and are doing it in many cities.

Underground conduits and conductors for electric lighting and power, provided with due care and deliberation, need not increase the fixed charges of companies doing a reasonable extent of business to such an extent as to be prohibitory.

The transmission of electric current is entirely analogous to that of gas, water or steam, and must inevitably, in the not very distant future, be conducted underground, as they are. To electric light companies, as to gas, water and steam companies, the legislatures and law-making bodies should give rights enabling them to meet the condition in the manner calculated to produce the best results for the companies and the public users, and if the above recital of causes and effects, experiences and results in New York city will tend to prepare the way to avoid to other companies the experiences of those in New York city, the relator will feel justified with his effort, as he is appreciative of the compliment implied by the invitation of our worthy President, which has afforded the opportunity to offer it for your consideration.

On February 24 the Building Trades Council indorsed the position of the striking electrical workers at the World's Fair grounds, and as a result a committee of five from the Council will wait on the World's Fair officers and demand that the men who were discharged be reinstated and their demands acceded to. The result of a refusal, it is said, will be the calling out of every union man in the 28 building trades on the grounds. The following is a statement of the cause of the trouble: Last week a number of electric wire and linemen in the employ of the New York Insulated Wire Company, which is putting up the systems of the Westinghouse and the Exposition Companies, demanded an increase of pay from $2.50 to $3 for an eight-hour day's work. The company refused to advance the wages and the men left. Fifty went out on that day and it is claimed that only about 20 of the 500 men originally employed are now at work. One of the labor officials declared that "the demand of the men will be supplemented by the contractors, who will be compelled to suffer." It is reported that Superintendent Burnham had sent to St. Paul and St. Louis for help. The striking linemen have appointed committees to wait upon all incoming trains and take care of any new men that may arrive.